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OF THE

PROFESSOR OF AGRICULTURE,

KANSAS STATE AGRICULTURAL COLLEGE.

EXPERIMENTS.

1883-85

MANHATTAN, KANSAS:
PRINTING DEPT., STATE AGRICULTURAL COLLEGE.
1884.

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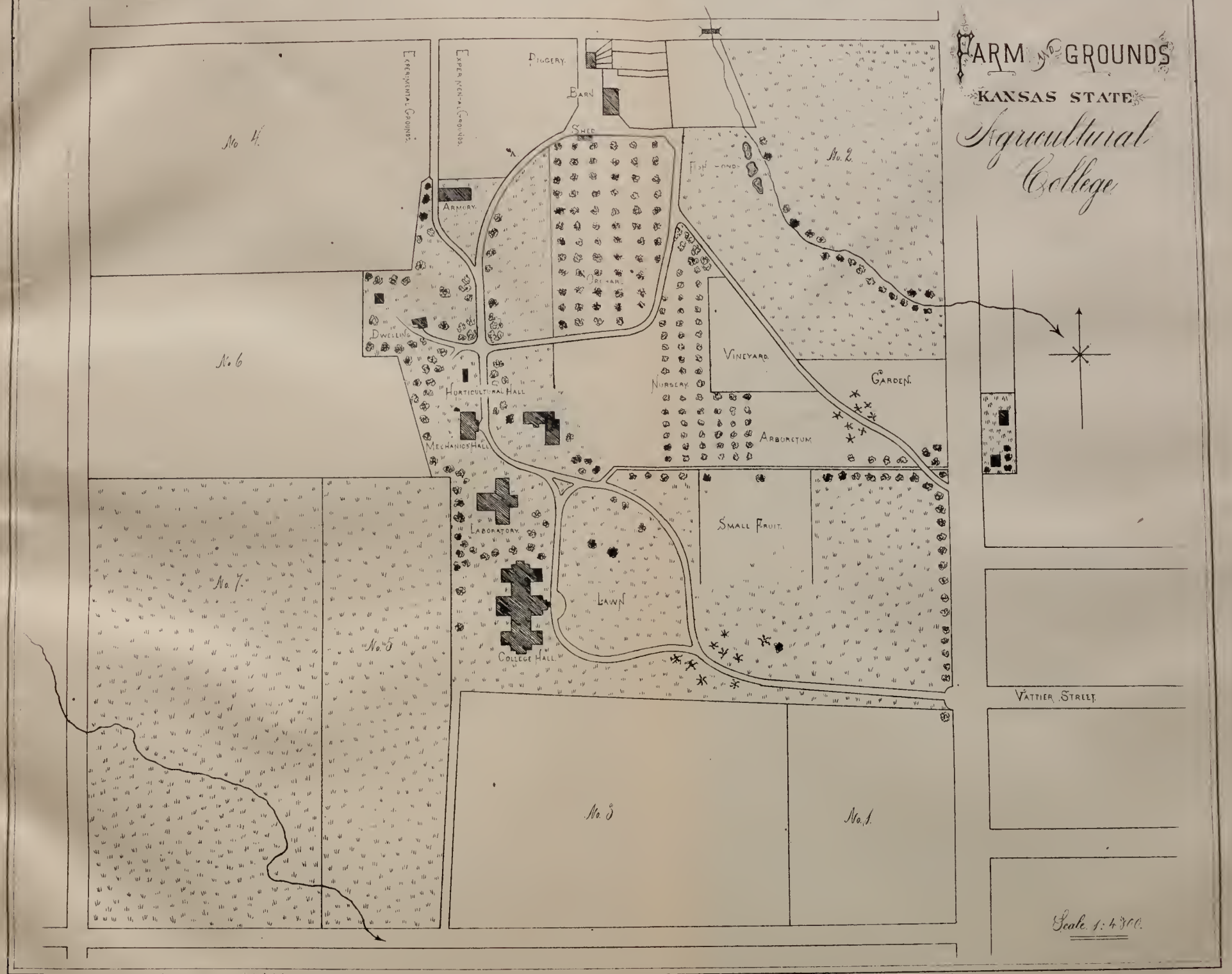
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Experimental Grounds
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REPORT

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PREFACE.

In submitting to the public this report of experimental work in the Farm Department, I desire to say that it is not given as representing fully the work of the Department. The College Farm is not an experimental station, although fairly well equipped for practical and experimental work. Rather the farm is maintained as a part of the educational machinery of the College. Its object is to furnish instruction to the students of the College, no less than to aid, by experimental investigation, general agriculture. It should be said, however, that the policy is to enlarge, as far as practicable, the experimental work of the Farm Department.

The general scope of my work will be understood from the statement that during the year covered by this report, besides having the management of the College Farm of 271 acres, including the various experimental undertakings, I have taught large classes in Agriculture and Stock-breeding, Anatomy and Physiology, Dairying, U. S. History and Rhetoricals.

The substance of the first article on Pig-feeding presented in this report was given in a paper read before the Society for the Promotion of Agricultural Science, at the meeting held at Minneapolis, Minnesota, last August.

I am under special obligations to Regents Coburn, Kellerman and Gifford, of the Farm Committee, for the hearty interest they have shown, in many ways, in the work of the Department; and to students who have carefully worked out much of the details of these experiments.

E. M. Shelton,
Professor of Agriculture,
Superintendent of Farm.

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EXPERIMENTS.

To the Board of Regents of the Kansas State Agricultural College:—

GENTLEMEN—Herewith is submitted a detailed statement of experiments made by the Farm Department in the year 1883, together with some references to the work of previous years.

Respectfully,
E. M. SHELTON,
Professor of Agriculture and Superintendent of Farm.

STATE AGRICULTURAL COLLEGE,
Manhattan, Kansas,
January 15th, 1884.

PIG-FEEDING EXPERIMENTS.

The object of this experiment was to ascertain how much, if any, cold weather and exposure during the most inclement season affect flesh-production in fattening pigs. Essentially, the experiment detailed below is a repetition of that made during the winter of 1880-81, a full account of which may be found in the report of the Secretary of the Kansas State Board of Agriculture for 1879-80, page 436.

In the experiments made two years ago, two of the pigs in each series were fed a ration of bran in addition to corn, the object being to determine to some extent the value of bran as an adjunct to corn in feeding. The bran was found to be practically worthless (See Report of the Secretary of the State Board of Agriculture 1879-80, p. 441) to the pigs to which it was fed. This bran ration, however, complicated the experiment in its principal object, so that it has been deemed best, in the experiment under consideration, to employ as feed corn only.

In this experiment ten pure-bred yearling Berkshires were employed, and, although of three different but closely related litters, their differences of age in no case equaled a month. The lot was remarkably uniform in appearance, and in the possession of excellent feeding qualities. The uniformity of the pigs, and their excellence for the purposes of this experiment, are further shown by the fact that during the entire period of the experiment none of the pigs were injuriously affected, in appetite or digestion, by the peculiar regimen to which they were subjected.

During the summer preceding the time of this experiment, these pigs were kept in pasture fields which furnished, besides prairie grass, a supply of alfalfa and orchard-grass. In addition to this pasturage, each animal received a daily allowance of one to two ears of corn.

Five of these pigs, Nos. 1 to 5 inclusive, were fed in the basement of a warm stone barn, each pig occupying a separate pen; the remaining five, Nos. 6 to 10 inclusive, were fed in pens in the open yard, without other protection than that afforded by a high board fence on the north of each pen. All of these pigs were fed twice daily — at 8 A. M. and 4 P. M.,—and all were given water *ad libitum*. The feed in all cases was shelled corn, which was carefully weighed at each feeding, great care being taken that each animal had all that he could eat without waste. The pigs were weighed at the beginning of the experiment and at the end of each week, and a careful record made of all weighings. The readings of Fahrenheit's thermometer at 8 A. M. daily were also recorded as the temperature of the day. For the "average weekly temperature," the average was taken: not a strictly accurate calculation, but sufficiently so for the purpose or this experiment. In Tables Nos. I. and II. the general results of this experiment from two points of view are summarized.

TABLE No. I.

WEIGHT OF EACH PIG EACH WEEK OF THE EXPERIMENT, THE TOTAL GAIN, AND TOTAL GAIN PER CWT.

	WEEK OF THE EXPERIMENT.	PIGS KEPT IN WARM PENS IN THE BARN.					PIGS KEPT IN OPEN PENS IN THE YARD.				
		Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.	Pen 10.
November 27th, ...	Beginning of Experiment.	252	211	223	214	214	200	227	196	237	204
December 4th, ...	1st week.	269	222	235	228	228	218	251	216	257	209
" 11th, ...	2d week.	275	244	257	253	251	234	270	236	271	232
" 18th, ...	3d week.	293	253	268	262	258	244	278	249	288	246
" 25th, ...	4th week.	309	271	285	275	295	253	289	241	299	242
January 1st,.....	5th week.	315	279	291	285	277	263	299	259	315	261
" 8th,..... ...	6th week.	324	282	305	290	287	262	295	269	321	266
" 15th,.....	7th week.	343	301	319	311	296	278	319	276	338	270
" 22d,.....	8th week.	346	308	330	322	301	283	323	272	344	275
" 29th,.....	9th week.	356	317	337	334	316	283	334	289	360	286
February 5th,.....	10th week.	373	330	347	346	322	288	337	283	363	282
Total gain.....		121	119	124	132	108	88	110	87	126	78
Total gain per cwt.,.		48.00	56.40	55.60	61.50	50.40	44.00	48.40	44.30	53.20	38.20
Average gain per cwt., ...		54.20					45.90				

TABLE No. II.

SHOWING THE AMOUNT OF FEED CONSUMED EACH WEEK IN EACH PEN, TOGETHER WITH THE TOTAL FEED, AND AVERAGE AMOUNT OF FEED, FOR ONE POUND OF INCREASE.

Weeks of Experiment.	Pigs kept in warm pens in the barn.						Pigs kept in open pens in the yard.					
	Av. w'k temp.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Av. w'k temp.	Pen 6.	Pen 7.	Pen 8.	Pen 9.	Pen 10.
1st Week	38°	46.50	39.50	47.50	47.50	47.50	31°	48.50	47.50	48.50	50 50	48.50
2d "	34	54.00	59.00	59.00	60.50	60.50	22	63.50	64.00	68.50	65 50	65.50
3d "	35	65.50	66.50	67.00	65.00	65.00	22	64.50	67.50	69.50	69 50	70.00
4th "	42	67 50	66.50	67.50	64.00	68.50	30	64 00	67.50	61.00	74.50	66.50
5th "	32	63.50	65.00	61.50	63.00	59.50	15	63.50	63.50	60.00	74.00	61.50
6th "	22	56.00	56 00	56.00	55.00	54.50	5	55.50	48.00	52 50	66.50	52.00
7th "	29	59.50	58 50	58 50	58.50	59.50	18	55.50	52.00	52.00	72.00	48 00
8th "	19	56 00	55.50	55.00	55.00	50.50	-12	45.00	50 50	43 50	64.50	44.00
9th "	27	51.50	52.50	53 00	53.60	52.50	15	43.50	46.50	46.50	63 00	49 50
10th "	21	57.50	56.00	56.00	53.50	51.00	2	38.50	43.00	43 00	57.00	44.50
Total amount of feed consumed.		577.50	575.00	581.00	575.00	569.00		542.00	550.00	545.00	657.00	550.00
Av. amt. of feed for 1 lb. increase.		4.73	4.84	4.79	4.35	5.26		6.15	5.00	6.26	5.21	7 05

TABLE No. III.

SHOWING THE AMOUNT OF FEED CONSUMED WEEKLY FOR EACH 100 LBS. OF LIVE WEIGHT OF PIG.

Weeks of Experiment.	Pigs kept in warm pens in the barn.						Pigs kept in open pens in the yard.					
	Av. temp.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Av. temp.	Pen 6.	Pen 7.	Pen 8.	Pen 9.	Pen 10.
1st Week	38°	17.8	18.6	18.9	21,4	21,0	31°	23.2	19.8	23.5	24 4	23.4
2d "	34	21.3	25.3	23.9	25,1	25,2	22	28.0	24.5	28.9	24.8	29.7
3d "	35	22.6	26.7	25.5	24,7	25,5	22	26 9	24.6	28 6	24.8	29.2
4th "	42	22.3	25.3	24.4	23.8	22.9	30	25.7	23.8	20.8	25.3	27.3
5th "	32	20.3	23.6	21.4	22 5	20.8	15	24.6	21.6	24.0	24.1	24.4
6th "	22	17.7	20.0	18.7	19.1	19.3	5	21.1	16.1	19.8	20.9	19.7
7th "	29	17.8	20.0	18.7	19.4	20.4	18	20.5	16.9	19.0	21.8	18,2
8th "	19	16.2	18,2	17.1	17.3	16.9	-12	16.0	15.7	15.8	18.8	16.1
9th "	27	14.7	16.8	15.8	16,1	17.0	15	15 3	14.1	16.5	17.6	17.6
10th "	21	15,5	17.1	16.0	15,7	16,5	2	13.4	12.8	15.0	15.9	15,6

TABLE No. IV.

SHOWING THE GAIN OF EACH PIG DURING EACH WEEK OF THE EXPERIMENT. THE NUMBERS HAVING THE MINUS SIGN PREFIXED INDICATE A LOSS IN WEIGHT.

Weeks of Experiment.	Pigs kept in warm pens in the barn.						Pigs kept in open pens in the yard.					
	Av. w'k. temp.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Av. w'k. temp.	Pen 6.	Pen 7.	Pen 8.	Pen 9.	Pen 10.
1st Week	38°	17	11	12	14	14	31°	18	24	20	20	5
2d "	34	6	22	22	25	23	22	16	19	20	14	23
3d "	35	18	9	11	9	7	22	10	8	13	17	14
4th "	42	16	18	17	13	17	30	9	11	8	11	4
5th "	32	6	8	6	10	2	15	10	10	18	16	19
6th "	22	9	3	14	5	10	5	1	4	10	6	5
7th "	29	19	19	14	21	9	18	16	24	7	17	4
8th "	19	3	7	11	11	5	12	5	4	4	6	5
9th "	27	10	9	7	12	15	15	0	11	17	16	11
10th "	21	17	13	10	12	6	2	5	3	6	3	4

TABLE No. V.

IN WHICH THE GENERAL RESULTS OF BOTH SERIES ARE GROUPED IN PERIODS OF ONE WEEK EACH.

	Pigs kept in warm pens in the barn.				Pigs kept in open pens in the yard.			
	Average temperature.	Total feed.	Total increase.	Corn consumed to produce 1 lb. of increase.	Average temperature.	Total feed.	Total increase.	Corn consumed to produce 1 lb. of increase.
1st Week	38°	228½	68	3 30	31°	243½	87	2.79
2d "	34	293	98	2.98	22	327	82	3.98
3d "	35	329	54	6 10	22	341	62	5.50
4th "	42	334	81	4 12	30	333½	19	17.55
5th "	32	312½	32	9.76	15	322½	73	4 41
6th "	22	277½	41	6.76	5	274½	16	17.15
7th "	29	294½	82	3 58	18	279½	68	4 11
8th "	19	272½	37	7.32	-12	247½	16	15.46
9th "	27	262½	53	4 94	15	249	55	4.61
10th "	21	274	58	4.72	2	226	1	226.00
Totals and Averages		2878	604	4 76		2844	479	5.93

From the above tables, we gather by a brief computation that the 2,844 pounds of corn, which in the "outside" pens gave 479 pounds increase in the weight of the pigs, would have given, had it been fed in the warm barn, an increase in the weight of the pigs amounting to 597 pounds. Or, to view the subject from another standpoint, the 479 pounds of increase made in the "outside" pens, would, at the cost of the increase made in the warm barn,—namely, 4.76 pounds of corn for one pound of increase,—have required the expenditure of 2,280 pounds of corn, plus a fraction, instead of the 2,844 pounds of corn actually fed; showing that the five pigs fed "outside" used up 564 pounds of corn to furnish heat which had radiated from their bodies into space.

The facts above stated are much more strikingly, and much more fairly shown, if we take, as the basis of our reasoning, the behavior of these experimental pigs during the period of the greatest cold, namely, the 6th, 8th, 9th and 10th weeks. I find, referring to Table No. II., that, during this

time, the five pigs fed in the yard consumed 997 pounds of corn, and increased in weight 88 pounds. At the same rate of cost of increase, maintained during the same time by the pigs in the warm barn, this 997 pounds of corn would have given 172 pounds of increase. It also follows that the 88 pounds of gain made in this time in the "outside" pens, would, in the warm barn, have required 502 pounds of corn, instead of 997 actually fed "outside;" showing that but little less than one-half of all the corn fed in the "open" yards during the prevalence of the severest cold was employed in keeping piggy's body comfortably warm, and in nothing else.

TABLE No. VI.

		Total increase.	Total corn consumed.	Corn consum'd for each 1 lb. of increase.	Increase for each bu. corn (56lbs) c'us'm'd
Period of highest temperature,—1st, 2d, 3d and 4th weeks.	Pigs kept in the barn.....	301	1,184	3.93	14.23
	Pigs kept in open yards.....	270	1,245	4.61	12.14
Period of greatest cold,—6th, 8th, 9th and 10th weeks.	Pigs kept in the barn.....	190	1,086½	5.71	9.80
	Pigs kept in open yards.....	88	997	11.43	4.90

In the above Table (Table No. VI.), a comparison of the behavior of the pigs kept in the barn and those in the open yards is made during the four weeks of highest temperature and the four weeks of the greatest cold.

It is found that during the period of highest temperature when mild winter weather prevailed (the average temperature in the barn was 37 degrees, outside 26 degrees) the pigs in the barn made a much larger increase in weight (31 pounds) than those in open yards, upon less corn (61 pounds,) giving a pound of increase for about four-fifths of the corn required by the pigs in the exposed pens. In the period of *greatest* cold this variation is much more marked, except in the total corn consumed, the pigs in the barn consuming 89½ pounds more of corn than those kept outside. The small amount of feed consum-

ed outside, during this period, is safely attributable to the severe weather that prevailed during the time referred to.

The principal results of this experiment may be shown in a few brief comprehensive statements: —

(1). In the warm barn 2,877½ pounds of corn gave 604 pounds increase in the weight of the pigs, while in the open yards 2,844 pounds of corn gave 489 pounds of increase.

Or, in the exposed pens, the cost of 1 pound of increase was almost twenty-five per cent greater than the cost of 1 pound of increase in the warm barn.

(2). Besides giving less of "total gain" and "gain per cwt." in every pen, during every week of the experiment, the pigs fed outside gave much smaller returns for feed consumed, but this was especially marked during the weeks of lowest temperature.

Thus, during the three weeks of greatest cold, the pigs in open yards required 17.15, 15.46 and 226 pounds of corn for each pound of increase, while in the warm barn, during the same three weeks, 6.76, 7.32 and 4.72 pounds of corn respectively were expended for 1 pound of increase.

(3). In this, as in the experiment made two years ago, I have observed that the quietest pigs, the "best feeders," suffered least from cold, ate the best, and gave the largest returns for feed consumed.

(4). The fluctuations in the weekly gain were very much greater in the pens in the open yards; but, as shown in Table No. IV. whenever little gain, or a positive loss was sustained—as in the pens 8 and 10, during the 4th week, and pens 6 and 7, during the 6th week — an enormous gain was made, during the week following, even though the temperature continued low, as though the animals were making a determined effort to recover lost ground.

(5). The fluctuations in the total feed consumed, or in the amount of feed consumed for each 100 pounds of live weight of animal, were not great in the different pens, or in different weeks of each pen, although these fluctuations were greatest in the "outside" pens, the smallest amount of

feed being consumed during the coldest weather. It is worthy of remark, however, that in the weeks following those showing the least gain in flesh or the greatest loss. when the largest increase was made, as stated above, the increase in the amount of feed was inconsiderable; in some cases nothing. Thus in pens 6 and 7 in the 6th week, and in pen 8 in 4th and 8th weeks, the pigs lost 1, 4, 8 and 4 pounds respectively, while in same order consuming 55½, 48, 61 and 43½ pounds of corn. During the week following, when the same pigs gained in weight, 16, 24, 18 and 17 pounds, the enormous gain was made at a cost of 55½, 52, 60 and 46½ pounds, respectively, of corn.

TABLE No. VII.

SHOWING THE GENERAL RESULTS OBTAINED IN BOTH SERIES, IN PERIODS OF TWO WEEKS EACH.

		Total increase.	Corn consumed.	Corn consumed for each pound increase live wt.	Average weight of pigs.	Corn consumed for each 100 lbs. live weight.
1st period, 1st and 2d weeks.	Pigs kept in the barn	166.00	521.50	3.14	239.4	43.56
	Pigs kept in the open yard	169.00	570.50	3.37	230.7	49.1
2d period, 3d and 4th weeks.	Pigs kept in the barn	135.00	663 00	4.91	271 5	48.82
	Pigs kept in the open yard	81.00	674.50	8.32	256.7	52.54
3d period, 5th and 6th weeks.	Pigs kept in the barn	73 00	590.00	8 08	292.3	43.62
	Pigs kept in the open yard	89.00	597.00	6.70	273.4	43.66
4th period, 7th and 8th weeks.	Pigs kept in the barn	119.00	567 00	4.76	309.5	36.60
	Pigs kept in the open yard	84.00	527.00	6.27	291.0	36.20
5th period, 9th and 10th weeks.	Pigs kept in the barn	111.00	536.50	4.83	332.5	32.26
	Pigs kept in the open yard	55.00	475.00	8.61	305.0	31.08

From this Table we gather certain facts long familiar to attentive feeders of swine, all of which are briefly summarized as follows:—

(1). That as the pigs became fatter the cost of producing a pound of gain increased while the total increase made, the total corn consumed, and the corn consumed for each 100 pounds of live weight of animal, progressively diminished.

(2). The pigs when consuming the largest amount of feed gave the largest increase for corn consumed, as well as the largest total increase. The line of variation, however, as shown in Table No. VII., is never uniform, but is broken from a variety of causes, among which changes of temperature are certainly prominent. Doubtless, had longer periods been taken in the above Table (No. VII.), these abrupt changes would have been less noticeable, if seen at all.

This experiment agrees in its results with the one made by me two years ago, and both show unmistakably that farmers and stockmen who fail to furnish their swine with proper artificial protection against cold weather must furnish protection of another kind in the shape of fuel for the "internal fires" of the animal. Which "heating apparatus" is the cheapest, must be decided by everyone for himself; but where, as we have shown, 495 pounds of corn were used up in keeping five pigs warm four weeks, there would seem to be no question about the profitableness of employing good cheap shelter for pigs during the feeding season. May we not also reasonably expect that the facts here adduced hold good in the case of all domestic animals, whether kept for meat or milk or the work they perform?

For convenience in comparing results, we give below, in tabular form, the general facts growing out of the experiments made in the winter of 1880-81:—

TABLE No. VIII.

		Total pounds corn consumed.	Total increase, lbs.	Total amount bran consumed.	Corn consumed for each 100 pounds of live weight.	Bran consumed for each 100 pounds of live weight.	Corn consumed for each pound of increase.	Bran consumed for each pound of increase.
Feed: Corn.	Pens 1, 2 and 5 in the barn.	2,487	483	....	22.03	....	5.15	....
	Pens 6, 7, 10 in open yard....	2,291	418	....	21.64	....	5.48	....
Feed: Corn & bran.	Pens 3 and 4 in the barn....	1,589	330	232	21.09	4.13	4.81	0.70
	Pens 8 and 9 in open yard..	1,386	240	200	19.82	4.14	5.77	0.83

From the above Table is seen that in the outside pens in which corn exclusively was fed 33.06 pounds more of cor were required to produce 100 pounds of increase than in the warm barn; and in those pens in which corn and bran together were fed, the increased cost of producing 100 pounds of increase in the outside pens was 96.19 pounds of corn and 13.03 pounds of bran. This experiment showed, also, a very trifling value for the bran consumed, 8.42 pounds of the corn giving the same increase as 75.78 pounds of bran.

PIG-FEEDING EXPERIMENTS, No. II.

AN ESTIMATE OF THE VALUE OF MILK TO YOUNG PIGS.

In a previous chapter of this report the results of feeding well-grown pigs during the most inclement season of the year, under different conditions as to shelter and warmth, are detailed. In that experiment, Indian corn was the exclusive diet of the pigs. As first planned, a varied dietary was arranged in expectation of being able to furnish facts showing the feeding values of different food stuffs. But on reflection this plan was abandoned, the mixed diet in connection with the original object of the experiment (to show the influence of cold and exposure upon the fattening process) involving a problem of too great complexity, when, as in this case, chemical values were not considered. The behavior of the pigs during the experiment, and results obtained, confirmed the general opinion of the excellence of corn alone as food for fattening pigs. That corn in any form is an indifferent food for young and *growing* pigs is a fact supported on equally common experience. I am inclined, however, to go further than this, and assert that none of the common grains, however prepared, will in that critical period of the pig's life, the 2d, 3d and 4th months, give that rapid and symmetrical development of the animal sought by all well-informed owners of swine. A continuation of the animal food which nature supplies in the outset of the pig's career, seems to be demanded long after he has acquired a taste for other food. Most breeders of swine will agree with me in this statement; but the question of the *actual* feeding value of milk to young pigs, as compared with some other food stuff, will certainly develop a great variety of opinions. The truth is, that in this, as in every department of agriculture, we need facts upon

which to base correct opinions which in turn will give rise to a rational and profitable system of agriculture. Everyone will agree that milk is a valuable food for young animals; but, when we wish to calculate beforehand which will pay best, to feed the milk of the farm to the pigs, or to convert it into butter or cheese, we can only make a crude guess.

Below are given the principal facts growing out of an experiment recently concluded in which 10 pigs were fed in two sets of five each, one set receiving a ration of fresh milk twice daily in addition to shorts and water, while the other set was limited to a diet of shorts and water.

The pigs employed were pure-breds of the Essex breed, the offspring of stock obtained directly from Mr. Joseph Harris of Rochester, New York. In this, as in my previous experiments, the pigs were kept singly in pens numbered 1 to 10 inclusive. Without doubt, the results obtained in this experiment, would have been more valuable had a larger number of pigs been employed. However, the fact that these pigs were strikingly uniform — all being purely-bred and almost identical in blood — makes the facts here obtained of much greater worth than any that might be had from the feeding of a much larger number of ill-assorted animals.

The uniformity of the lot at the beginning of the experiment (July 5th) is seen at a glance in the following facts: —

No. 1, boar; age, 53 days; weight, 32 pounds.
" 2, boar; age, 53 days; " 32 "
" 3, sow; age, 53 days; " 32 "
" 4, sow; age, 107 days; " 51 "
" 5, sow; age, 107 days; " 63 "
" 6, sow; age, 53 days; " 27 "
" 7, boar; age, 53 days; " 26 "
" 8, sow; age, 107 days; " 50 "
" 9, sow; age, 107 days; " 54 "
" 10, sow; age, 107 days; " 46 "

Numbers 1, 2, 3, 6 and 7 were of the same litter; and numbers 4, 5, 8 and 9 were of another litter.

The pigs were arranged in two sets of five each, Nos. 1 to 5 inclusive receiving milk fresh from the cow and wheat shorts, mixed in the form of slops, Nos. 6 to 10 getting shorts and water in the same form. The pigs were fed twice daily, the feed in all cases being accurately weighed, and great care was taken that each animal received just the amount of feed that he required and no more. All the pigs received whatever water they required. The weight of each pig at the end of each week was taken and recorded. In the following Table (No. I.), the general facts of the experiment are stated in the case of each pig, together with the average cost of one pound of increase in both series. In this and in the succeeding Tabels, the results obtained in Pen No. 4 are omitted. The pig occupying this pen was taken with a severe attack of the "thumps" early in the experiment, on which account he was withdrawn.

TABLE No. I.

	Wt. each pig at beginning experim't.	Wt. of pig at end of experiment.	Total gain.	Total gain per cwt.	Total feed, lbs.		Feed consumed for each 100 lbs. live wt. pig.		Cost of 1 lb. increase.		Average cost of 1 lb. of increase.	
					Milk.	Shorts.	Milk.	Shorts.	Milk.	Shorts.	Milk.	Shorts.
Pen No. 1.	31	124	93	300	517	247	667 0	318.7	5.55	2 65		
" " 2.	32	121	89	278	517	224	673.2	292.8	5 80	2 51		
" " 3.	32	127	95	296	517	249	650.3	313 2	5.44	2 62	5.16	2.60
" " 5.	63	192	129	204	546	338	428.2	265.0	4.23	2.62		
" " 6.	27	73	46	170		207		414.0		4.50		
" " 7.	26	76	50	192		209		409.8		4.18		
" " 8.	50	124	74	148		311		357.4		4.20		4.21
" " 9.	54	131	77	142		326		352 4		4.23		
" " 10.	46	122	76	165		308		366.6		4.05		

TABLE No. II.

SHOWING THE FACTS OF THE EXPERIMENT IN BOTH SERIES BY WEEKS, THE AVERAGE FEED CONSUMED FOR EACH POUND OF INCREASE, THE TOTAL FEED, TOTAL GAIN, TOTAL GAIN PER CWT. OF ANIMAL.

	Pens 1, 2, 3 and 5. Feed: Milk and Shorts.						Pens 6–10. Feed: Shorts.			
	Total feed.		Total gain.	Total gain per cwt. of pig.	Total feed (lbs.) for 1 lb. increase.		Total feed, lbs.	Total gain, lbs.	Feed for 1 lb. increase.	Av. gain per cwt. of pig.
	Milk.	Shorts.			Milk.	Shorts.				
July 5th–12th, 1st week	221	27	23	14.55	9.60	1 17	74	23	3.21	11.33
" 12th–19th, 2d "	231	56	58	27.48	3.98	.96	112	27	4.14	11.94
" 19th–26th, 3d "	229	84	29	12.13	7.79	2 89	127	23	5.52	9.09
" 26–Aug. 2, 4th "	224	95	44	17.74	5.09	2.15	131	35	3.74	12.68
Aug. 2d–9th, 5th "	238	110	48	16.38	4.95	2.29	137	27	5 07	8.68
" 9th–16th, 6th "	228	127	43	11.94	5.30	2.95	140	40	3.50	11.83
" 16th–23d, 7th "	203	131	36	8.93	5.63	3 63	150	34	4.41	8.99
" 23d–30th, 8th "	187	143	48	9.85	3.89	2.97	162	26	6.23	6.31
" 30–Sept. 6, 9th "	168	143	36	6.88	4 66	4.66	164	34	4.82	7.76
Sept. 6th–13th, 10th "	168	144	41	7.26	4.09	3.51	164	54	3.03	11.44
Total and average results	2097	1060	406	132.14	5 16	2 60	1361	323	4.21	

The above Tables furnish the essential facts growing out of this feeding trial. It will not be thought amiss if I go further than the Tables and show some of the facts clearly deducible from them.

As will be observed, the average cost of one pound of increase in the pens in which the feed was milk and shorts was 5.16 pounds of the former, 2.6 pounds of the latter; while in the pens in which shorts alone was fed the average cost of each pound of gain was 4.21 pounds of shorts. It follows from this, then, that 5.61 pounds of milk had in this trial a feeding value equal to 1.61 pounds of shorts; one pound of milk equaling a little less than three-tenths (0.287) of a pound of shorts. If we take as the standard of value the price of the shorts, which was $1.00 per cwt., we see that one pound of milk had a feeding value of rather more than one-fourth (0.287) of a cent. This estimate which

is based upon *the gross increase* of live weight only, assigns a very low value to milk, and one considerably below that which the dairyman or milk dealer would give it. But the increased gain in the gross weight of pigs here placed to the credit of the milk, really shows but a small part of the work done by it. What may be called the indirect uses of the milk to these young pigs may be concisely stated as follows:—

(1). In the case of the pigs belonging to the younger litter, those receiving the milk ration were made ripe and ready for the butcher in 100 days; those receiving the shorts alone were quite unsalable at the end of the experiment.

(2). The value per pound of the milk-fed pigs was nearly or quite double that of the pigs to which the shorts was fed. I am unable to speak accurately here, for while the pigs which had received the milk sold at the conclusion of the experiment at the highest market price, the pigs which had been fed on shorts alone, were, with possibly two exceptions, quite unsalable except as "stockers." Indeed, three of these pigs which were turned loose in the yard, where they have been well fed and cared for ever since, do not weigh as much to-day as did their mates, which received the milk ration, at the conclusion of the experiment four months ago.

(3). The pigs to which the milk was fed were started upon a career of usefulness; they got an impetus, a momentum, which it is not unreasonable to suppose they would not have subsequently lost had they been kept under ordinary circumstances of feed and care.

(4). To the breeder and fancier the advantages obtained by the milk-fed series over the set receiving shorts alone, would have appeared even greater than to the farmer or stock-raiser interested only in pork-making. The pigs receiving the milk were larger of body, and in all respects better and more symmetrically developed than the others. Their skins shone as though they had been oiled; while

the series receiving shorts, especially the younger ones, had dull, lusterless, scurfy skins, which gave to them a markedly stunted appearance.

The quality of the flesh of the milk-fed pigs was highly commended by the butchers. It contained a large proportion of lean meat, while the "fat" was well marbled, firm, and of that agreeable nutty flavor which characterizes the best quality of pork. This fat did not waste in cooking,—by changing to oil on the application of heat,—as corn-fed pork usually does.

From a careful study of all the facts of this experiment, we conclude, and unhesitatingly affirm, that the surplus milk of the farm over and above that used in the family of the farmer can, as prices now are, be more profitably fed to young pigs than applied to any other purpose for which milk is ordinarily sold away from the farm.

EXPERIMENTS WITH FARM-YARD MANURE, SUBSOILING, AND THICK SEEDING OF CORN.

In the spring season of 1883, sixteen plats were laid off in field No. 6 for the purpose of showing the influence upon the corn crop of farm-yard manure, and different methods of seeding and cultivation.

The soil upon which this experiment was made was a strong clay loam, overlying a friable clay subsoil, having a gentle and uniform slope to the west. This ground had been in continuous cultivation for eleven years, during which time it had been manured two or three times, the last time in 1879. A crop of millet was grown upon the land in 1882.

The general plan of the experiment may be stated as follows: the sixteen plats ranged continuously from north to south; each plat was 10½ feet wide by 207½ feet long (one-twentieth of an acre), and every plat was separated from the one nearest it by a two-foot-wide space which was not cultivated. For the purpose of comparison, every pla especially treated was separated from the next of the series by a "nothing" plat, these zero plats in every case being occupied by three rows of corn which received ordinary cultivation. In the plan of the experiment which follows, the position and arrangement of the specially treated plats are shown. The manured plats received well-rotted farm-yard manure at the rate of twenty-eight tons per acre.

The absence of the Plats I, J, K should receive a word of explanation. Plats I and K were planted *without* plowing at the time of the planting of the other plats. A succession of warm rainy days, however, which brought the weeds forward in great force, prevented cultivation,

PLAN OF EXPERIMENT.

SIZE OF PLATS 10½ x 207½ FEET=1-20 ACRE.

NORTH.

Plat A—six rows of corn 1¾ feet apart.

Plat B—nothing.

Plat C—six rows of corn, 1¾ ft. apart.

Plat D—nothing.

Plat E—subsoiled.

Plat F—nothing.

Plat G—subsoiled.

Plat H—nothing.

Plat L—nothing.

Plat M—manured.

Plat N—nothing.

Plat O—manured.

Plat P—nothing.

and compelled the abandonment of the experiment. These plats, with the "nothing" plat separating them, were plowed up and planted with cow-peas.

In the subsoiled plats the subsoil plow was run to the depth of three or four inches in the furrow, directly in the wake of the common stirring plow working to the depth of six inches.

TABLE No. I.

NAMES OF PLATS AND THEIR TREATMENT.	Yield of Plat, corn, lbs.	Yield of Plat, stalks, lbs.	Yield per acre, corn bu. (70 lbs.)	Yield per acre, stalks, tons.	Quality of corn.
Plat A—six rows, planted 1¾ ft. apart	227.5	200.0	65.00	2.00	Poor, ½ nubb'ns
Plat B—nothing	188.5	150.0	53.85	1.50	good.
Plat C—six rows, planted 1¾ feet apart	233 5	180.0	66.71	1 80	poor.
Plat D—nothing	194.0	190.0	55.43	1.90	med.
Plat E—subsoiled	177.0	152.0	50.57	1.52	med.
Plat F—nothing	200.0	168.0	57.15	1.68	good.
Plat G—subsoiled	177.0	145.0	50.57	1.45	med.
Plat H—nothing	177.0	142.0	50 57	1.42	good.
Plat L—nothing	231.0	210 0	66.00	2.10	good.
Plat M—manured	242.0	240.0	69.15	2.40	good.
Plat N—nothing	205.0	180.0	58.57	1.80	v. good.
Plat O—manured	187.0	205.0	53.43	2.05	good.
Plat P—nothing	230.0	197.0	65.71	1 97	good.

SUMMARY.

	Yield of Plat, corn, lbs.	Yield of Plat, stalks, lbs.	Yield per acre, corn bu. (70 lbs.)	Yield per acre, stalks, tons.
Plats A and C—corn; drilled in rows 1¾ feet apart	230.50	190.00	65.86	1.90
Plats B and D—nothing; plats adjacent plats A and C	191.25	170 00	54.64	1.70
Plats E and G—subsoiled	177.00	148.50	50.57	1.48
Plats D, F and H—nothing; plats adjacent plats E and G	190 33	166.66	54.38	1.66
Plats M and O—manured	214.50	222.50	61.28	2.22
Plats L, N and P—nothing; plats adjacent plats M and O	222.00	195.66	63.42	1.95

Great care was taken in the arrangement of the experiment that every plat received exactly the treatment accorded to every other—except in the special features of the experiment—in the time of working, amount of seed, and the condition of the crop at the time of harvesting.

The Table given above (Table No. I.) shows, concisely, the yield of each plat in corn and stalks, the yield per acre, the quality of the corn, together with a summary of the yield of the specially treated plats and the "nothing" plats adjacent to them.

The thick-seeded plats were occupied by *six* rows of corn $1\frac{3}{4}$ feet apart.

In all of the plats the corn was drilled, and, except in the special case, mentioned above, in rows $3\frac{1}{2}$ feet apart. The corn used in this experiment was the medium-sized King Phillip variety.

The results obtained in the manured and subsoiled plats will doubtless surprise many. The idea that manure is always useful to crops, and that subsoiling and deep plowing are always beneficial processes, is widely spread. The fact that the labors of the farmer, so far as they affect growing crops, are applied wholly to the soil and subsoil gives to these factors of the crop an exaggerated importance in the minds of most persons. It is not my purpose in this report to theorize or to explain facts, but to state them. It seems worth while, however, to draw attention here to the fact, that to that other important factor in growth of crops, the season, we must look for an explanation of the peculiarities in the results shown in the above table.

The corn plant is of tropical origin. It revels in hot sunshine and a warm moist soil. In such a soil it roots deeply, and absorbs rapidly both of water and food. The past season has been one of remarkably low temperatures. According to the records of the Chemical Department of the College, the temperature for June was 2.79 degrees; for July, 5.11; degrees and for August, 4 degrees,—

in each case below the average temperature of these months for the past twenty-three years. Now, the manure applied in this experiment was put in the bottom of a six-inch-deep furrow; the subsoiling was done at a still greater depth, and the plants failed to get much benefit of either because the low temperature prevented deep rooting, and it hindered the decomposition of the manure, so that it is more than possible that the manure was a positive loss, as shown by Plat O.

Dr. Sturtevant, Director of the New York Experiment Station, in one of the bulletins of the Station, refers to a similar experience in his work, as follows:—

"In 1883, at no time during the summer did our soil at one inch deep attain a temperature of 90 degrees F. Of the ninety-three observations in July of the temperature at three inches deep, but seven were over 80 degrees; the highest being 84½ degrees, the lowest, 54½ degrees. In August, of ninety-three observations, but three were over 80 degrees; the highest being 85 degrees, the lowest, 54½ degrees. As the temperature for the best root-growth of maize is given by Sachs at 81 degrees, and as absorption of water and food by the plant is less with a low than with a high temperature, it would have been expected that our crops of his year would not have shown to any great extent the effect of applied fertilizer. That this is true reasoning, is evident—not proved—by the results which were as below calculated to the acre from one-tenth acre plants, in bushels of 80 lbs. ear corn:—

Fertilizer of preceding year; per acre.	Yield per acre 1883.
0 pounds.	60 bushels.
200 "	60 "
400 "	61 "
800 "	67 "
1600 "	66 "

"In a duplicated series, where potatoes were planted, the same fertilizer in the same quantities being used, the influence of the fertilizer was well marked, *because the potato is a cool temperature plant.*"

The Table shows that the plats in which the corn was drilled in rows $1\frac{3}{4}$ feet apart yielded 65.86 bushels of corn and 1.96 tons of stalks per acre, while the "adjacent" plats which held precisely one-half as many rows of corn, gave a yield of 54.64 bushels of corn and 1.70 tons of stalks per acre; a gain for thick seeding of 11.22 bushels of corn and 400 pounds of fodder. These figures should receive the careful consideration of every Kansas farmer. If by planting corn in rows a little nearer each other than is the general practice, we can get even an equal yield of corn as compared with the ordinary method of planting, the method of thick seeding has a great advantage over the common practice, in that the fodder is not only greater in amount, but vastly improved in quality. The great difficulty with corn fodder as ordinarily produced in Kansas is that the very coarse, inedible stalks are greatly in excess of the blades, — the really valuable portion of the plant; and, besides, the labor of handling this coarse fodder is very great. Thick seeding in checking the rank growth of the stalk greatly improves the fodder by increasing the proportion of blades to the stalks, in the fodder.

This question of cheap fodder is one of prime importance to Kansas agriculture. If by planting corn thickly we can get a very large yield of superior fodder and in addition a good crop of corn, as was obtained in this experiment. even though the corn is inferior in quality, it is proved that corn has scarcely a rival among plants that produce cattle food. As above stated, the quality of the corn yielded in the thick seeded plats was not the best. Perhaps one-half was nubbins. But such corn is well suited to the wants of that large number of cattle feeders who feed their corn with the stalks, directly from the shock.

The labor of cultivation was much less in the thick-seeded plats than in those planted in the common way. The dense growth of stalk and blade completely smothered the growing weeds, thus reducing the work of cultivation to occasional superficial stirring of the surface soil. The

hint furnished by this experiment with thick seeding seems to be well worth acting upon by Kansas farmers.

In 1882 an experiment in subsoiling, not before published, was made on ground adjoining that on which the above detailed experiment was made. In this experiment six plats, $\frac{1}{3}\frac{1}{2}$ of an acre each, were used, each alternate plat being subsoiled, the remaining plats plowed simply. All were planted and cultivated at the same time, and in the same ordinary fashion. The annexed Table shows the outcome of the experiments so far as the corn product is concerned. The stalks were so severely damaged late in the season, by a violent storm, that no satisfactory record could be made of the yield. A cold, backward spring, and the ravages of the cutworm, are the facts which explain the light yields of the several plats.

TABLE No. II.

NAMES OF PLATS AND THEIR TREATMENT.	Yield of plat; lbs. corn in ear.	Yield per acre; bus. of 70 lbs.
Plat No. 1—subsoiled	282	42.9
Plat No. 2—nothing	256	36.0
Plat No. 3—subsoiled	262	39.9
Plat No. 4—nothing	233	35.5
Plat No. 5—subsoiled	250	38.0
Plat No. 6—nothing	255	38.8
SUMMARY.		
Plats 1, 3 and 5—subsoiled, average yield	264 6	40 2
Plats 3, 4 and 6—nothing, average yield	248	37.7

The influence of subsoiling is seen in each plat so treated, but that influence, it will be observed, was nowhere very great. If this influence is limited to a single season, the increased yield,—two and one half bushels per acre,—will not nearly pay the cost of subsoiling.

EXPERIMENTS WITH VARIETIES OF WHEAT.

In the fall of 1881, seventy varieties of winter wheat and eighteen spring sorts were sown in contiguous plats in field No. 6. Of the eighteen spring sorts, only six survived the winter, and of these, only the Odessa, Improved Fife and White Fife gave fair yields of grain. Of the seventy winter sorts, seventeen seemed especially suited to the conditions of Kansas agriculture, and were reserved for further experiment. (A full report of the behavior of all of these sorts was published in the *Industrialist* of September 19th, 1882.) These sorts, namely, Early May, Fluke, German Amber, Finley, Michigan Amber, Champion Amber, Orange, Red Amber, Small Frame, Blue Stem, Red Chaff, Zimmerman, McGhee's Red, Walker, Hungarian, Heige's Prolific and Rust Proof, were sown in adjoining plats—size 10x30 ft.—in the fall of 1882. The yield of the several sorts in straw and grain, the estimated yield per acre, the proportion of straw to grain, and the effect of the winter upon most of the sorts, are shown in the subjoined table. By an unfortunate accident in threshing, the identity of a few of the above named sorts was lost.

TABLE No. I.

KINDS OF GRAIN. Plats 10x30 ft.	Yield of Plat grain, lbs.	Yield of Plat straw, lbs.	Yield per acre grain, bushels.	Yield per acre, straw lbs.	Straw (lbs.) to 1 lb. of grain.	Quality of grain.	REMARKS.
Finley	10.25	27.75	24.80	3,029	2.6	Good.	Much winter killed.
Orange	13 25	36.75	32.06	5,336	2.6	Good.	
Red Amber	7 50	22.50	18.15	3,267	3.0	Good.	Badly winter killed.
Small Frame	16.75	28.25	40.53	3,101	1.6	Very good.	
Blue Stem	9.75	30.25	23.60	4,392	3.1	Medium.	One half winter killed.
Red Chaff	12.25	42.75	29.47	6,207	3.4	Poor.	Slightly winter killed.
Zimmerman	7.72	22.25	18.75	3,230	2.8	Good.	
Hungarian	9.25	39.75	22.35	5,771	4.2	Medium.	
Rust Proof	6.75	32.00	16.33	4,646	4.7	Poor.	Much winter killed.
Walker	11.75	24 50	28.41	3,557	2.0	Good.	Badly winter killed.
Heige's Prolific	7.75	35.75	18.75	5,200	4.6	Medium.	

This Table teaches, if it teaches anything, the total unreliability of facts based upon a single year's experience.

All of the above sorts, from the experience of one year ago, seemed well suited in all respects to Kansas agriculture. In the experience of the past year, many are seen to be peculiarly susceptible to freezing, others yielding indifferently of grain of inferior quality.

Those old Kansas sorts, Early May,—not referred to in the Table,—Zimmerman and Orange, did not winter-kill or rust, and gave satisfactory yields of grain of excellent quality, as they have done in this section for several consecutive years.

The really excellent crops of grain and straw obtained from varieties that had suffered greatly by winter-killing, as in the cases of the Finley, Blue Stem and Walker, serve to enforce the truth familiar to observant wheat-growers in most sections of the country; namely, that *the crop is largely determined by the character of the spring season.* Now, the spring months of 1883 were peculiar on account of the uniform cool, "backward" weather which prevailed far into June. This cool weather, with the full average of moisture that accompanied it, was exactly suited to the needs of the enfeebled wheat plants, and the results show that they made the best of their opportunities. Every plant "stooled" amazingly, so that when harvest came, the ground seemed occupied with vigorous straw. Had the spring been one of high temperatures and rapid plant growth, the effects of the winter-killing would have been much more plainly shown in the yield.

Another fact of interest observed in connection with the growth of these wheats was the great difference in the tillering habits of the different sorts. The Walker, Blue Stem and Finley "stooled out" wonderfully, while the Rust Proof, Red Amber, and some others, seemed to possess the tillering habit but feebly. This fact indicates that a material variation in the amount of seed of the different sorts might profitably be made. This tillering habit

doubtless explains the large yields from small amounts of seed which are so frequently reported.

WHEAT CONTINUOUSLY ON THE SAME GROUND.

A measured acre of ground in Field A has been cropped with winter wheat for three consecutive years, commencing with the fall of 1880. The object of this experiment has been to study the effect upon the ground and crop of continuous wheat-growing upon the same soil, without manures or intervening restorative crops of any kind. The acre in question is a strong clay loam of about average fertility, having a gentle and uniform slope to the east. In 1880, it grew a rank crop of cow-peas, which were plowed under when in bloom. Although the experiment has only been in progress three years, and of course gives small hint of its ultimate outcome, yet the subjoined facts may not prove uninteresting: —

YIELD OF 1-ACRE PLAT OF WINTER WHEAT.
Variety: Early Red May.

YEAR.	Yield of grain, bus.	Yield of straw, lbs.	Straw (lbs.) to pound of grain.
1880-81	9.00	—	—
1881-82	47.00	7,845	2.7
1882-83	28.19	3,281	1.9

THE CULTIVATED GRASSES AND CLOVERS.

My experience with the "tame grasses" in Kansas upon the College Farm covers ten years. During this time a very large number of varieties have been tested, some through a series of years, others during shorter periods of time.

I desire in this chapter to state the facts of this experience, in the hope that they may prove useful to the large class of farmers living in the central portions of the state, whom necessity has compelled to seek for some substitute for the rapidly disappearing native grasses. I wish to say, however, in the outset, that my experience in this section of the state (Manhattan and vicinity) will not prove in all respects a reliable guide to those living along the eastern border, or to those whose farms are in the buffalo grass region of the West. The kinds of grasses, and methods of cultivation, in vogue in Kentucky and Missouri, are useful in Kansas over a belt of country extending several miles west from the Missouri river. The kinds and methods of cultivation best suited to the wants of the drier portions of the state have not yet been found out. The farmers living in the western, and so far as the tame grasses are concerned doubtful, region of the state, will do well to give to their wild meadows the treatment best calculated to make them permanent. No grasses now known can surpass these native sorts, in the ability to withstand drouth and the depredations of insect enemies, and I doubt if any grass known, equals them in nutritive qualities and the amount of feed furnished, at least during the summer months.

Many times each year the question is asked me, Can tame grasses be *profitably* grown in Kansas? To this I reply unhesitatingly, that over most of that portion of

Kansas lying within one hundred and fifty miles of its eastern border, they can be and are profitably grown. Ten years ago, this was one of the open questions. The cultivated grasses were then all but unknown in the newer portions of the State, and were generally considered of doubtful value, if not entirely superfluous. Now these grasses are grown upon a great number of the farms in large fields, and by the most thoughtful farmers are considered necessary to the most profitable system of farm management. This shows real progress in agriculture.

The Best Kinds.—I do not wish to be understood as saying that there are not peculiar difficulties in the cultivation of the tame grasses in this section of Kansas. Every soil and climate compels certain agricultural condition and practices in farming, and when, as has been the case in Kansas, these conditions are unknown, we encounter "difficulties." No grass or clover can be permanently successful in Kansas which has not the ability to withstand, without injury, long continued high temperatures and occasional severe drouths, and in addition it must be a perennial or self-seeding sort. The grasses and clovers which in our experience have shown themselves to possess these qualities in the highest degree are, taking them in the order of their value, alfalfa, orchard-grass, red clover and tall meadow oat-grass and English blue-grass. For the use of those living in the eastern portion of the State, we should add to this list Kentucky blue-grass, English blue-grass (*Festuca elatior*) and timothy.

The Soil and Its Preparation.—In our experience, the best results have been obtained with most sorts of tame grasses upon a fertile clay loam, resting on a permeable clay subsoil. But, let it be remembered, land can hardly be too rich or too highly manured for grasses. Indeed, we have found that not only are the largest yields obtained upon such fertile lands, but the effect of insect depredations is greatly lessened. Of course, comparatively poor

lands, in Kansas as elsewhere, will grow grass; but poor lands produce poor crops everywhere. Better far, commence the growth of the tame species of grass before the land has become impoverished by injudicious cropping.

But, whatever may be the character of the soil, prepare it as well and thoroughly, by plowing and harrowing, as for any grain crop. This is a rule with scarcely any exception; and its violation in many ways explains a large proportion of the failures that have attended the attempted cultivation of tame grasses in Kansas. The question is asked us many times every year, Why may I not scatter the seed upon wild sod as is often done in the East? This is often done; but the practice, so far as our experience and observation have gone, has resulted in almost uniform failure. Where the prairie sod has been largely destroyed by the tramping of cattle, we have known blue-grass to succeed partially; but, even in this case, a better sod would have been obtained in less time by thoroughly subduing the land, by two or three years of cropping, before applying the grass seed. As before stated, in the eastern counties of the state, this practice is successfully followed; but even here we are satisfied it would pay the farmer much better, and he would obtain a better sod nearly as quick, if he would take the "wildness" out of the land with two or three grain crops before seeding.

Seeding with Grain Crops. — Oats, wheat and rye are often recommended as excellent crops with which to sow grass seed. The argument is, that the tall grain will shade and protect the young grass. But grass does not need shade when sown in proper season: it needs the sun: and, especially, it needs moisture, and this the vigorous grain is continually taking from the soil, thus robbing the young grass from the start. Every farmer knows how spindling, sickly, and how lacking in strength of root and stem, is a grass or clover plant growing in a dense mass of grain. When this grain is harvested in June or July.

just when the summer heats are greatest, the delicate, starved grass plants are certain to perish, unless long continued, cool and cloudy weather prevents.

We are aware that, on favorable seasons, considerable success is obtained by seeding the grass with another crop. But, even during these favorable seasons, a better and more vigorous stand may be obtained without the rivalry of vigorous grains; and, upon dry seasons, a failure of the grass is almost certain, when seeded with a grain crop.

When to Sow.—The time to sow grass seed is, without exception, in the spring; and recent experience shows that this work should not be undertaken too early in the season. In the spring of 1880, a field seeded early in April came to nothing, the violent dry winds that followed the sowing completely sweeping the seed away. Seed sowed after the spring rains have fairly set in has never failed since 1874 to give a good stand of grass. In a few instances, and where the winter following has been warm and open, we have had good success with timothy and clover sown in fall; but the result of sowing orchard-grass, alfalfa and blue-grass in the fall, has been almost certainly disastrous. My experience with grass seed sown in the fall has been this: they germinate readily, even more quickly than in spring, but, as the native vegetation fails from the action of frosts, the young grasshoppers collect upon the young grass, doing it serious damage; what remains suffers seriously, and is often quite destroyed by the action of the frosts and violent winds of early spring. On the other hand, when the seeding is done too late in the spring, the young and tender plants are consumed by the sun as fast as they appear above the ground. Seed sown any time during the month of April will rarely fail to germinate and make a vigorous growth. However, I cannot advise seeding, as before said, until the warm spring rains set in. I have sown both alfalfa and orchard-grass during the early part of May with excellent results.

Alfalfa, or Lucern, (*Medicago Sativa*). For Kansas, but particularly for western Kansas, alfalfa is probably the most valuable of the clovers. In the central and eastern portions of the state—and in the southwestern portion along the Arkansas river, where irrigation is practiced,—it has generally proved a most invaluable forage crop. It will prove valuable only in warm climates. North of the parallel 40 degrees north latitude I should expect it certainly to fail. Alfalfa demands an old rich soil containing some moisture; a climate, in which during the summer, blazing suns and an atmosphere heated to the point of suffocation are the rule. Nevertheless, a large portion of those who undertake to grow alfalfa will fail, at the first attempt. More accounts come to me of failures with alfalfa than any other clover or grass that we have had any experience with. Let me emphasize two or three of the matters about which most of these failures cluster. Inquiry into the cause of these has satisfied me that the character of the subsoil has much, perhaps most, to do with success or failure with alfalfa. A soil overlying a tenacious, impermeable subsoil should be avoided in the cultivation of the plant. Prepare the ground thoroughly, by plowing and harrowing. Sow not less than twenty pounds of seed per acre, and sow this about the middle of April: harrow in lightly, following with a roller if possible. Do not be discouraged if the plants make a feeble growth during the first season, as they usually do. Alfalfa should not be pastured or mowed during this first and critical season. The mower should occasionally be run over the ground high enough to miss the alfalfa and cut off the tops of the weeds. After this season, the alfalfa will take care of itself and all the weeds within its reach. Alfalfa is perennial, perhaps eternal: at all events, it will outlive the "oldest inhabitant," if it gets good treatment. The danger which threatens it most is the pocket-gopher, which, by burrowing among and cutting the roots of alfalfa, has destroyed several acres of valuable meadow upon the

College Farm. Severe cropping by cattle and swine during the summer and late in the fall ought also to be avoided. Alfalfa makes good pastures for stock of all kinds, and is quite unequaled among forage crops for "hog pastures."

It yields enormously of hay, of an inferior quality, I am bound to add. We have cut four crops, of a ton and a half of hay per acre, from the same ground the past year. Nevertheless, in a country which gets its moisture directly from the clouds, it will not pay to raise alfalfa for its hay. Alfalfa should have much field room after cutting. If dried hastily, the valuable portions of the plant, the leaves, will break off in handling and be lost, and only woody, inedible stalks remain. It should be cured slowly in the winrow and "cock," at best a slow operation; and if, meanwhile, a considerable shower falls, the hay is almost certainly ruined beyond recovery.

Alsike Clover (*Trifolium hybridium*). This clover is highly recommended for wet, heavy lands upon which the ordinary clovers cannot be grown. However, in perfectly dry situations, in seasons favorable to vegetation in general, I have obtained a very large yield of hay upon well-manured clay land. During years of drouth it will kill out seriously. Eight to ten pounds of seed, sown in the spring, should give a sufficient stand.

Bermuda Grass (*Cynodon dactylon*) has been quite extensively introduced into Kansas from southern Missouri and Arkansas during the last two or three years; and extravagant claims have been made for it by interested parties. After three years' experience with this grass on a considerable scale at the College Farm, I have no hesitation in saying that for this section, — and we are confident, generally throughout the state, — it is quite worthless either for hay or pasture. Of all the "tame grasses," it is latest to appear in the spring, and the lightest frost cuts it off level with the ground. Until the hot weather of June had set in, our Bermuda grass showed scarcely any

sign of life and growth. But even then the amount of feed which it furnishes is quite insignificant. Moreover, our stock of all kinds showed no great fondness for it, leaving it always for Orchard-grass growing near by. It is possible that in exposed positions, or on poor sandy soils which cannot give support to the more vigorous species, this grass may be useful. It grows vigorously, turning its energies chiefly to the production of root-stocks with which it fills the soil, and—I say it with much regret—it is not apparently injured by our winters. I am confident that our farmers will do well to keep their farms clear of a grass which, like the Bermuda grass, has some of the worst qualities of the most pernicious weeds.

English Blue-Grass (*Festuca elatior*). In the eastern portions of the state this grass is deservedly a favorite. With us it has been an uncertain crop, yielding largely during seasons favorable to vegetation in general, but suffering from protracted dry weather. I have found two bushels to be sufficient seed for one acre.

Foul Meadow Grass (*Poa serotina*). This old-fashioned sort, long a favorite in New England for wet soils, has done nothing with us, even in a season so favorable for grass as was last year. I doubt if it has any place in Kansas agriculture.

Johnson Grass (*Sorghum halapense*) has been highly recommended for this state. An experience of two years with it does not confirm the good opinions that have been formed of it. In the outset, I experienced a difficulty, common with the seed of this grass,—only a small portion germinated. The straggling plants that appeared, however, grew and thickened rapidly, so that the ground was before fall fairly well occupied by the coarse, rank-growing stalks which finally gave a fair yield of quite inferior hay. In quality, it resembles the coarsest of swale grass. During the winter of 1882–83 the cool weather apparently destroyed it entirely. I was unable after a careful examination to find a single living root. However, in June a few

scattering blades appeared, whether from seed or root I am unable to say, and these gradually increased in number during the season.

Our experience with this grass may be summed up in a few concise statements:—

1. Good seed is not easily obtained, and damp cold weather rapidly injures its germinating powers.

2. It is one of the latest grasses to appear in the spring, being considerably behind prairie grass in this respect.

3. It is (apparently) destroyed "root and branch" by our severe winters.

4. The quality of the grass seems to be inferior; at all events, our stock has never relished it.

The single fact that Johnson grass makes no growth to speak of before June 1st is decisive upon its value in Kansas.

Kentucky Blue-Grass (*Poa pratense*). This grass may be grown almost anywhere in the now settled portions of the state. We have never failed to secure a good stand, and ultimately a good sod,—even during such very dry seasons as 1875,—when good seed was sown on well-prepared land, and at the proper season, which is in the spring. However, our experience with the grass,—a very extended one, by the way,—has convinced me that, for all useful purposes except lawns, in central and western Kansas, this is one of the most worthless of tame grasses. It starts early in the season, and for a short time yields a small amount of quite inferior feed; but in May it ripens its seed, the grass becomes brown, dry and fibrous, and in this dormant condition it remains until fall, and often until the following spring. Moreover, dry weather will almost certainly injure Blue-grass seriously, when no damage is sustained by Orchard-grass and Clover in the same field. On the other hand, in the eastern portions of the state, particularly in the counties bordering the Missouri river, I know from personal observation that Blue-grass thrives abundantly, and is a very profitable grass.

I can easily see that this grass possesses great value for a region like Illinois and Kentucky, where winter rains abound, enabling it to make a slow and continuous growth; but the Kansas winter is generally our dryest season, and for this reason I doubt much if this old favorite sort has any place in our agriculture. To obtain a good stand quickly, Blue-grass seed should be sown in the early spring; and, in amount, not less than three bushels per acre of ground.

Orchard-Grass (*Dactylis glomerata*). Our first considerable seeding of Orchard-grass was made in 1875. During each subsequent year we have sown more or less of this grass, and every season's experience with it has fully confirmed the good opinion which we early formed and have so frequently expressed concerning it. (1) In the ease with which a "stand" is obtained, (2) in its ability to withstand drouth and the ravages of insect enemies, (3) in the abundance of pasturage which it furnishes, and (4) in nutritive qualities, Orchard-grass is not surpassed by any other sort. In most of these respects, indeed, it is greatly superior to any other grass with which I have experimented. In this section of Kansas I should advise sowing five acres of Orchard-grass to one of all other sorts of grasses or clovers.

Orchard-grass is one of the earliest grasses to start in the spring, and the last to succumb to frost in the fall. By giving it a good start in the fall, it will furnish good pasture far into the winter. It is consumed with great relish by stock of all kinds, especially if the grass is cropped short. It seems to do equally well upon heavy clay and sandy soil; and any rich and well-drained soil seems suited to it. It germinates about as easily as oats; and, with good seed, no difficulty is experienced in getting a "stand" that will endure moderate cropping the first fall after seeding. As might be inferred from its common name, it does best when moderately shaded, and is admirably suited to orchard culture; yet there are few grasses

that will so well endure the prolonged sunshine of our dry seasons. It should, however, be remembered that Orchard-grass will not make a sod as Blue-grass does. It always grows in tussocks, or bunches; and, to counteract this tendency, seed should be sown with a liberal hand. Not less than 1½ bushels of seed should be sown per acre: and two would perhaps be better. I have obtained excellent results by adding to the above three quarts of Red Clover seed. The clover has always thrived with the Orchard-grass besides furnishing to animals that variety of food so agreeable to the taste. I have found that Orchard-grass is relished even by swine, and therefore it makes excellent "hog pastures." In my experience, too, no amount of tramping or close grazing at any season has been able to injure a well-rooted sod.

Orchard-grass will endure late seeding better perhaps than any other sort; but this operation ought not to be delayed much beyond the middle of April.

Tall Meadow Oat-Grass (*Avena elatior*). This old-fashioned English sort has recently been extensively sold in the West under the name of Evergreen Grass. An experience of two years with it enables me to speak very positively of its merits. It yields much more of hay than Orchard-grass, but less pasturage. It makes a much more vigorous growth than Orchard-grass the first year after seeding, but during the protracted dry, hot weather of last season it showed much less vigor than Orchard-grass. Tall Meadow Oat-grass is well worth a thorough trial at the hands of Kansas farmers. However, it ought to be borne in mind that this sort is still in the experimental stage of cultivation. About two and one-half bushels of seeds per acre should be sown.

Red Clover (*Trifolium pratense*) deserves a prominent place in the list of forage plants suited to eastern and central Kansas. In 1874 and 1875, two exceptionally dry seasons, it failed almost entirely here, giving neither pasture or hay. But during the favorable seasons which

have since prevailed, it has flourished abundantly, and has yielded more—both of hay and pasture—than is generally obtained in the East. I have in one season cut two excellent crops of hay and a crop of seed from the same ground. Red Clover in this state has one interesting peculiarity worth mentioning. When land is once seeded, it never "runs out," as is the case in the East but thickens and spreads continually by self-seeding. A piece of ground seeded with Red Clover in 1872 gave a large yield of clover hay last year. I believe that nowhere are such large crops of clover seed grown as in Kansas. Red Clover is worth a trial anywhere in the state. Already it has taken a high place in the agriculture of the eastern and central portions of the state, where its cultivation is rapidly extending. In very dry seasons, however, it lacks the "staying" qualities so remarkable in Alfalfa. But while drouth generally reduces the yield of clover, as of all other crops, it will rarely, upon clay soil, permanently injure the plants. Regarding the relative merits of clover and Alfalfa,—a question often raised,—I have to say that while clover yields scarcely more than half the hay or pasturage given by Alfalfa in the point of quality, Alfalfa is greatly inferior. The stalks of Alfalfa are nearly solid, and woody, and the waste in feeding is great as compared with clover. I am decidedly of the opinion that where clover is successfully grown no farmer will long cultivate Alfalfa.

Perennial Rye-Grass (*Lolium perenne*). The high reputation which this grass has so long enjoyed in Great Britain induced me some years ago to commence on a small scale its cultivation upon the College Farm. My whole experience with it is explained in the single word *failure.* During very favorable seasons I have grown moderate crops of hay; but the scant yield of hay and pasturage generally furnished, and its inability to withstand dry, hot weather, stamp Perennial Rye-grass as peculiarly unsuited to the wants of Western farmers.

TIMOTHY (*Phleum pratense*). This sort, so valuable in the East as a mowing grass, has upon the College Farm shown itself almost continually inferior to most of the foregoing, in the following important respects: it gives no crop during dry seasons, and during seasons of severe drouth kills out severely, while its yield is light, even under favorable circumstances. Moreover, it suffers greatly from the attacks of insects. After an experience of ten years with this grass in Kansas, I am abundantly satisfied that there are few situations in Kansas where Timothy can be profitably grown. We need, above any other, forage pasturage; and this, assuredly, Timothy does not furnish.

The above-mentioned grasses and clovers are only a very small part of the total number that have been tested upon the College Farm. They are, however, the sorts that either have proved most useful, or are most likely to receive a trial by inexperienced farmers.

The Table given below may not be without interest as showing the yield at a single cutting of different grasses and clovers during the favorable season of last year. These sorts were grown in plats side by side, all receiving precisely the same treatment. A square rod of each was cut on June 18th. The cut grass was spread and exposed to the hot sun exactly forty-eight hours, when it was gathered and weighed. The different kinds, although generally in the condition of excellent hay, varied a good deal in quality. Nearly all might advantageously have been further reduced by evaporation fully twenty per cent.

	Weight of grass (lbs.) per rod.	Weight of hay (lbs.) per rod.	Yield per acre (lbs.) of hay.	Pounds green grass to one of hay.
Alfalfa	93	24	3,840	3.8
Alsike Clover	133	34	5,440	3.9
English Blue-grass	98	24	3,848	4.0
Fowl Meadow-grass	94	29	4,640	3.2
Orchard-grass	89	32	5,120	2.8
Red Clover	154	39	6,240	4.0

THE CULTURE OF THE MANGEL WURZEL.

A considerable experience in growing Mangel Wurzels and Sugar Beets upon the College Farm during several widely different seasons, has convinced me that Kansas farmers have in these roots an easily-cultivated field crop, and a cattle food that is admirably calculated to supplement the stimulating corn diet so generally used by our feeders during the winter season. Probably the Mangel is the best, if not the only, one of the "root crops" suited to the warm, dry climate of Kansas. During several seasons we have tried the Swedish Turnip, but have never yet succeeded in making even a moderate crop. Not so with the Mangel Wurzel. Even in such exceptional seasons as 1874, when combined drouth and grasshoppers effected the total destruction of the corn crop, we grew nearly three hundred bushels per acre of excellent Mangels. During subsequent favorable seasons, we have with ordinary cultivation made crops of six or seven hundred bushels per acre. With special care and attention, probably crops double or even treble the above amounts might be grown. I wish here to call attention to a few of the matters which the Kansas farmer who cultivates Mangels will do well to look to.

A common mistake is made in using the coarse "Mammoth" sorts of Mangels and Sugar Beets. It will always be found that these overgrown kinds, although yielding more largely than the finer grained "globes," are really much less profitable. They are more difficult to cultivate, and especially to harvest, and their coarse, spongy texture, and the large cores which they almost certainly contain, ren-

der them peculiarly liable to decay. We have also found these coarse beets to be less sweet, and less relished by stock than the smaller and finer kinds. We have had excellent success with the Yellow Globe Mangel as improved by Mr. Joseph Harris. The crop has been large and easily cultivated and harvested, while in respect to quality they are second to no other Mangel. Lane's Improved Sugar Beet has, with us, justified the good opinions which have so often been expressed of it. Kansas farmers will find both of these sorts incomparably better than the coarse-growing varieties generally cultivated.

The field management of Mangels presents but few difficulties. The soil should be of a good degree of fertility to begin with, but manuring, and especially thorough plowing and cultivation can hardly be overdone. At least three pounds of seed per acre should be drilled in rows thirty inches apart. It is especially important in Kansas that the seed be sown early. This operation ought not be delayed much beyond May 1st. The plants should be thinned out to spaces ten or twelve inches apart. If blank spaces appear in the rows, they should be filled by transplanting. A crop of Mangels puts the land in the best possible condition for succeeding crops, simply because a crop of Mangels and another of weeds cannot be grown upon the same land at the same time.

The storing and preservation of Mangels is another stumbling-block to beginners in root-culture. Our experience has shown that Mangels grow late in the season, enduring, without injury, a large degree of frost. For this reason, and because if pitted before the warm weather has ended, they are almost certain to rot, the work of harvesting should be delayed to as late a period as is consistent with safety. Last season we finished harvesting Mangels on November 12th. Mangels may be best preserved in pits, or rather in piles, for only the most superficial exca-

vations need be made for them. A light coating of straw on the piles of roots is sufficient when first put up: afterwards earth may be added. as the severity of the season increases.

Since losing a valuable Jersey cow in 1875 by choking with an irregular-shaped piece of Mangel, we have taken special care to minutely and uniformly slice all roots before placing them before cattle. There are various cheap machines which will do this work well, and with the expenditure of little power. The quite common practice of slicing roots with a shovel in a tub or other vessel is a dangerous one, because it is nearly impossible to reduce the pieces to uniform fineness, and these coarse pieces are a prolific cause of choking.

The feeding value of Mangels is well understood. A simple test applied last winter in the case of a milch cow illustrates the value of Mangels quite forcibly. A Shorthorn cow was fed morning and night for five successive meals four quarts of corn chop with a uniform ration of hay. At corresponding milkings she gave 15½, 17, 16½ 18, and 19 pounds of milk, an average of 17½ pounds of milk to the milking. The feed of the cow was then changed to one half bushel of Mangels morning and evening with the same hay ration as in the preceding trial. The result was seen in a yield of 20, 19, 16½, 19 and 18 pounds of milk respectively at five successive milkings, an average of 18⅖ pounds of milk to each milking. On account of the uses to which the milk was put, it was impossible to ascertain the amount of cream yeilded by the two kinds of feed. The fact, however, that the half bushel of Mangels gave a larger flow of milk than four quarts of corn chop is sufficient to show, without referring to the excellent sanitary influence of roots, the great feeding value of these roots.

THE CARP AS A FARM FISH.

Our experience with the German Carp began in April of 1881, when some 30 young fry of scale Carp were received from the United States Fish Commissioner at Washington. These were placed in a shallow pond, having a superficial area about 12 by 30 feet, which had been hastily excavated for their reception. The fish were occasionally fed, sometimes at intervals of two or three days, but often as many weeks would elapse without any food having been supplied them by artificial means. The feed used was scraps of bread and other vegetable food from the table, and occasionally corn-meal mush, prepared especially for them.

From the time the fish were placed in the pond, they were rarely seen. Pieces of bread thrown in the pond would bring them to the surface, but their favorite position seemed to be near the bottom of the pond, the mud of which they seemed to be almost continually turning up. In the summer, the pond became greatly reduced by evaporation until it held scarcely six inches deep of water. Nevertheless, and although the pond was absolutely devoid of grass and other ordinary vegetable growths, the Carp thrived, and grew amazingly. This growth is shown by the following figures :—

DATE OF WEIGHING.	Length of Carp, inches.	Weight of Carp, ounces.
April, 1881	2	
October, 1881	13	24
April, 1882	13	24
October, 1882	18	40
October, 1883	18	40

It is seen that no growth was made in either winter season, or during the entire year last past. This latter fact is probably explained by the facts that the fish bred enor-

mously during this year, and were badly crowded in ponds containing but little vegetable growth.

In the summer of 1881, a second and deeper pond was dug, which has since been used for the winter quarters of the fish. This pond is about 30 by 30 feet and holds, when full, three feet deep of water, an amount which experience has shown to be sufficient to prevent the complete freezing of all the water in the pond. During the entire winter, this pond has been, apparently, a solid mass of ice: and, although, during the past winter, by an accident to a sluice, the water drained out from beneath the ice, leaving scarcely six inches of water in the pond, no harm came to the fish.

At one year old, our Carp bred, but the increase was slight. During the summer of 1883, however, they increased enormously, the produce numbering thousands, which in many cases were four inches in length before fall.

I wish to emphasize a few of the considerations that must be heeded by the beginner who would be successful in Carp-raising:—

(1.) The supply of water for the pond must be under perfect control. If the pond is subject to overflow, the Carp will almost certainly be carried away by the first freshet. If, on the other hand, an uncontrolled flow of water enters the pond, there is danger from the entrance of such enemies as minnows, sunfish, snakes and turtles. The pond, or ponds,—for there ought to be at least two, one for breeding and the other for store fish,—should be generally shallow, abounding with deep holes.

(2.) The enemies of Carp in Kansas are chiefly the various predaceous fishes, turtles, snakes, wild ducks, and the bird known as the king fisher. The finny enemies of Carp must be kept away by a wire gauze, intersecting the stream feeding the pond. The turtles may be caught with fish-hook and line, and the gun will be found

efficient against turtles, snakes and birds. Of all the enemies of Carp, turtles have proved by far the most dangerous.

(3.) If the pond abounds in grass, flags, or weeds in quantity, the fish do not need to be supplied with food. But even where the pond furnishes good feeding grounds for the fish, a regular artificial supply of food will aid in giving the fish early and rapid development.

There is much dipsute about the eating qualities of Carp. By some it is claimed that Carp are equal to sal mon or trout in edible qualities, while others pronounce them to be totally inferior in flavor and quality. Probably the treatment the fish have received, and more especially the character of the soil underlying the pond in which the fish have been kept, the age of the fish, and mode of cooking, all influence the quality of the Carp, and thus produce these divergent opinions regarding them. Carp have not proved with us to be the best flavored fish, but they are greatly superior to buffalo fish, catfish, and most of our native fish, in quality and flavor. They are a bony, tolerably firm, fat fish, and the flavor, while quite pronounced, is not disagreeable. They will prove a welcome addition to the daily fare of most of the Kansas farmers who give them a trial.

THE PERIOD OF GESTATION IN COWS.

For upwards of ten years, the College herd of neat cattle has embraced three, and during a portion of the time four, breeds. These cattle are kept for various uses,—as illustrative apparatus, for experimental purposes, and, to some extent, for profit. But whatever their uses, a careful record is kept with all, and from this record the following facts are collated. My desire is, for various reasons, to have all cows drop their calves in the months of September and October; and, while this is not always practicable, it is probably true of the periods given below, that four fifths include the spring and summer months.

	Days of Gestation. Shorthorns.	Days of Gestation. Jerseys.	Days of Gestation. Galloways.	Days of Gestation. Devons.	Days of Gestation. Angus.	
1874	273			289		
1875	285	279	286	288		
1876	279	285	284	286		
1877	280	281	287			
1878	273	278	282			
1879	278					
1880	280	276				
1881	282	275				
1882	284	277	288			277
1883	284					

SUMMARY.

BREED.	No. of Bulls.	Average No. of days.	No. of Heifers.	Average No. of days.
Shorthorn	17	281	20	282
Jersey	4	281	10	277
Devon	3	289	1	286
Polled Angus	1	278	1	275
Galloway	3	286	2	285

Longest period, a Shorthorn, 590 days.

Shortest period, a Jersey, 268 days.

Mean of all, 62 periods, 281 days.

The above Table certainly shows that the fluctuations on account either of breed or sex are slight, although the statement of Mr. Darwin of observations made in Germany, that "the period of gestation is longer in large-sized than in small-sized breeds of cattle," gets slight support from it. The uniform condition which our cows have maintained as a result of the uniform treatment that they have received, doubtless explains the uniformity of their periods of calf-bearing.

In the oft-quoted facts furnished by Lord Spencer, the shortest period of gestation in 764 cows was 220 days, and the longest 313 days, while the average period was 285 days.

REPORT

OF THE

PROFESSOR OF AGRICULTURE.

KANSAS STATE AGRICULTURAL COLLEGE.

EXPERIMENTS.

1884.

MANHATTAN, KANSAS:
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1885.

PREFACE.

The report herewith submitted refers only to one branch of the work of the Farm Department. The College Farm is not an experiment station, although it has long been used extensively in experimental investigations. It sustains an important relation to the general educational work of the College, and is recognized as a part of the machinery of industrial education. Reports upon the educational work of the department, the general work of the Farm, stock, crops, etc., are made annually to the Board of Regents, and these reports are published biennially with those of the other departments of the College.

This report of experiments professes to give only the facts of experience accurately determined. Theories, and opinions respecting the results obtained, are not generally offered, in the belief that agriculture is likely to be advanced through the increase of our knowledge rather than by the multiplication of opinions which too often mislead.

Further, the experiments here detailed, as with experiments generally, will be found to be no more than suggestively useful to the majority of farmers. The unthinking adoption of facts brought out by experimental undertakings merits condemnation as much as their unthinking rejection. It is the duty of every farmer to take these facts and so modify them as the circumstances of his farm demand.

I desire to express my obligations to the members of the Farm Committee of the Board of Regents, Messrs. Coburn, Kellerman and Gifford, whose hearty support in the work of the department I have learned to count on with certainty; and to Mr. W. Whitney, Foreman of the Farm, and students of the College, to whose care much of the details of these experiments have been confided.

E. M. Shelton,
Manhattan, Kansas.

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EXPERIMENTS.

CORN MEAL AND CORN-AND-COB MEAL FOR FATTENING STEERS.

The question of the value of cobs as cattle-food, when ground with the corn which grew on them, is one about which farmers are by no means agreed. The writer, when attending meetings of stock-raisers, has been struck by the earnestness with which both sides of this question have been championed. In those parts of the East where the high values of cattle feed compel the practice of close economy in feeding, the quite common practice of feeding the cobs, ground with or without the grain, has the sanction of long experience. Even in the West, the large and increasing number of the various patterns of corn-crushers in use indicate a corresponding increase in the practice of feeding corn and cob.

It is interesting here in the outset to notice the chemical composition of corn and cobs and other food stuffs with which they are likely to be compared:—

	Water.	Ash.	Albuminoids.	Fibre.	Nitrogen-free extract.	Fat.
Corn—Western Yellow	13.93	1.25	8.82	1.59	70.48	3.92
Corn cob—Kansas Dent	9.25	1.16	1.91	31.22	55.85	.60
Oat straw	12.50	1.81	2.31	55.96	26.42	1.00
Hay—Timothy and Blue-grass	14.3	1.70	7.00	26.90	45.40	1.70

The analysis of corn cob was made by Mr. J. T. Willard, Assistant in the Department of Chemistry of this College. The analyses of corn and oat straw were made by Prof. W. O. Atwater, and that of hay by Prof. S. W. Johnson,

and are taken from the report of the Connecticut Board of Agriculture for 1879. While these figures show a considerable nutritive value to the cob, it must be said of them, as of the results of the analyses of food stuffs in general, that they are only suggestively valuable. The actual value of the various stock foods is an agricultural question that can only be determined by actual experiment.

The object sought in the experiment detailed below was the value of cobs when fed, ground with the corn grown upon them, to fattening steers. It was to be expected that, incidentally, some useful facts bearing on the cost in feed of producing a given weight of gain, the gain per steer, the total feed, and related matters, would be shown by the experiment.

In the autumn of 1883, ten steers were purchased for use in this experiment. These animals were selected by myself, with the sole object of securing animals that resembled each other in age, weight and feeding character. They were, with one exception, two-year-olds of the previous summer; the exception being steer No. 9, which was fully six months older than his fellows. The lot were undoubted range "scrubs" of the most pronounced character. Not one of them had ever been in a barn or shed or known shelter other than that furnished by the lee side of a bluff or the scant timber growing along prairie streams. Nevertheless, the lot was admirably suited to my purpose in this experiment. They were very uniform in weight, as a reference to the first horizontal column in Table No. I. will show, and they were as uniform in size and apparent disposition to fatten as in weight. Moreover, the lot having been raised together by the same man, under precisely the same conditions, brought to the work a similarity in appetites and tastes which especially adapted them to the requirements of the experiment.

The steers were tied up December 3d, in a plain battened board shed which had been prepared especially for them. Each animal was given a space four feet in width, with

ample alley room at the rear. From December 3d to December 19th the steers were gradually introduced to the full feed which was to follow. During this time, a small but gradually increasing ration of grain was fed with a diminishing feed of hay. In the outset, this difficulty in the management of the experiment was seen: the steers must have a daily feed of hay or other coarse fodder; and if this ration was varied to suit the wants of the different steers, the results of the experiment might be attributed as much to the variable quantity of fodder as to the difference in the quality of the grain fed. To obviate this difficulty, the steers were fed, as before stated, during this probationary period a quantity of fodder which was regularly reduced until the average minimum amount required by all was reached. During the entire progress of the experiment, the practice was to feed a uniform ration of fodder that was not so large but that it would be wholly consumed by each steer. This amount was found to vary from eight to ten pounds daily. The quality of this fodder varied from oat straw to a fair quality of mixed orchard-grass and clover hay. The regimen here provided—the maximum quantity of grain with the minimum amount of fodder—is strongly supported by the practice of feeders in this section of Kansas, who agree with practical unanimity in feeding the least amount of hay or other fodder possible, many going so far as to feed no fodder whatever during the time of fattening. The best possible justification of the course pursued in this experiment is furnished by the fact, conclusively shown in the tables which follow, that the steers made a continuous and rapid gain during the entire time in which they were fed.

Steers Nos. 1, 2, 3, 4 and 5 were fed, with the exception of fodder, exclusively upon meal made by grinding the whole ears of corn including cob; Nos. 6, 7, 8, 9, and 10 were fed, exclusive of fodder, corn chop made from shelled corn. All were fed twice daily with all possible regularity at 8 A. M. and 5 P. M., and all were watered once daily a

short time before the afternoon feeding. Each steer was fed all that he would eat of meal and chop, without waste; and an accurate record of the weight of each feed was kept. A lump of rock salt was kept constantly in the feed box of each animal. Every steer was weighed at the end of each ten days of the experiment.

The grain used was prepared by grinding with a mill of the "Giant" pattern, operated by two horses. I desire here to emphasize the importance of thorough grinding, especially where the cob is employed. Unless the cob is thoroughly pulverized—a difficult task with the cheap mills having slow motion—dainty animals will reject the coarse particles of cob which soon accumulate in considerable quantities in the feed boxes. I am fully convinced that the nearer to the condition of an impalpable powder ground feed is reduced, the greater its value.

In the tables following are given the weights of the steers during the progress of the experiment, with data in reference to gain (Table No. I.); the consumption of feed by each steer (Table No. II.); the average and actual gain as the feeding progressed (Table No. III.); the consumption of feed for one hundred pounds of steer (Table No. IV.); the cost in feed for one pound of increase (Table No. V.), while in Table No. VI., the general results of the experiment are shown in definite periods of time. In all cases the figures referring to weights in the tables indicate pounds and decimals thereof. Where, as in Tables No. III. and VI., the minus sign (−) precedes a number, a loss is indicated.

TABLE No. I.

WEIGHT OF EACH STEER EACH PERIOD (10 DAYS) OF THE EXPERIMENT, TOTAL GAIN, AVERAGE GAIN, GAIN PER CWT. AND AVERAGE GAIN PER CWT.

	FEED—CORN-AND-COB MEAL.					FEED—CORN MEAL				
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Dec. 19th, Beginning of Experiment	750	790	845	825	865	820	760	825	1030	800
Dec. 29th, 1st Period	805	823	892	830	922	827	775	875	1052	820
Jan. 8th, 2d "	805	840	900	835	940	845	800	865	1062	795
Jan. 18th, 3d "	845	845	925	865	975	870	820	815	1110	835
Jan. 28th, 4th "	850	880	945	870	975	890	845	875	1140	865
Feb. 7th, 5th "	840	880	950	870	1000	895	870	905	1150	890
Feb. 17th, 6th "	900	910	975	905	1020	930	865	930	1170	895
Feb. 27th, 7th "	910	952	1002	927	1065	957	915	952	1220	925
Mar. 8th, 8th "	885	960	1020	940	1080	980	930	970	1250	950
Mar. 18th, 9th "	920	980	1045	965	1110	1015	960	1015	1260	965
Mar. 28th, 10th "	910	999	1065	960	1085	1020	920	1020	1260	970
Apr. 7th, 11th "	915	995	1070	990	1150	1020	940	1020	1290	985
Apr. 17th, 12th "	985	1055	1120	1000	1170	1050	945	1070	1305	1020
Apr. 27th, 13th "	975	1080	1110	1040	1170	1065	970	1085	1325	1050
May 7th, end of Experiment	1010	1135	1180	1090	1240	1110	1005	1115	1370	1095
Total gain	260	345	335	265	375	290	245	290	340	295
Gain per cwt	35	44	39	32	43	35	43	35	33	37
Average gain			316					292		
Average gain per cwt			39					35		

TABLE No. II.

THE AMOUNT OF FEED IN POUNDS CONSUMED BY EACH STEER EACH PERIOD (10 DAYS), AND THE TOTAL AMOUNT OF FEED.

	FEED—CORN-AND-COB MEAL.					FEED—CORN MEAL.				
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
1st Period	165	146	176	151	150	133	145	165	188	121
2d "	111	134	140	111	163	124	112	110	192	80
3d "	133	136	159	120	137	132	119	129	170	124
4th "	158	157	175	151	181	140	135	158	193	149
5th "	156	155	169	160	184	147	148	179	200	151
6th "	148	148	173	144	200	164	165	161	200	147
7th "	153	162	163	153	196	162	161	170	198	147
8th "	125	137	131	153	165	146	159	167	198	133
9th "	122	145	145	140	122	170	180	178	200	159
10th "	152	157	160	142	181	177	176	173	200	135
11th "	169	168	172	161	168	160	160	166	176	165
12th "	183	155	204	180	200	162	194	181	207	152
13th "	213	206	220	219	223	179	214	218	219	195
14th "	203	233	234	223	236	169	175	215	234	201
Total feed consumed by each steer	2191	2239	2421	2208	2506	2165	2243	2370	2775	2059
Total feed consumed in each series			11565					11612		

TABLE No. III.

THE ACTUAL AND AVERAGE GAIN OF EACH STEER EACH PERIOD (10 DAYS) OF THE EXPERIMENT.

	FEED—CORN-AND-COB MEAL.					Average Gain.	FEED—CORN MEAL.					Average Gain.
	No. 1	No. 2	No. 3	No. 4	No. 5		No. 6	No. 7	No. 8	No. 9	No. 10	
1st Period	55	33	47	5	57	39.4	7	15	50	22	20	22.8
2d "	00	17	8	5	18	9.6	18	25	–10	10	–25	3.6
3d "	40	5	25	30	35	27.0	25	20	–50	48	40	16.6
4th "	5	35	20	5	00	13.0	20	25	60	30	30	33.0
5th "	–10	00	5	00	25	4.0	5	25	30	10	25	19.0
6th "	60	30	25	35	20	34.0	35	–5	25	20	5	16.0
7th "	10	42	27	22	45	29.2	27	50	22	50	30	35.8
8th "	–25	8	18	13	15	5.8	23	15	18	30	25	22.2
9th "	35	20	25	25	30	27.0	35	30	45	10	15	27.0
10th "	–10	10	20	–5	–25	–2.0	5	–40	5	00	5	–5.00
11th "	5	5	5	30	65	22.0	00	20	00	30	15	13.0
12th "	70	60	50	10	20	42.0	30	5	50	15	35	27.0
13th "	–10	25	–10	40	00	9.0	15	25	15	20	30	21.0
14th "	35	55	70	50	70	56.0	45	25	30	45	45	40.0

TABLE No. IV.

THE AMOUNT OF FEED CONSUMED EACH PERIOD (10 DAYS) FOR EACH 100 POUNDS LIVE WEIGHT OF STEER.

	FEED—CORN-AND-COB MEAL.					FEED—CORN MEAL.				
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
1st Period	21.2	18.1	20.3	18.1	16.8	16.1	18.8	19.4	18.1	15.0
2d "	13.8	16.1	15.6	13.3	17.5	14.8	14.2	12.6	18.2	9.9
3d "	16.1	16.1	17.4	14.1	14.3	15.4	14.7	15.4	15.7	15.2
4th "	18.6	18.2	17.6	17.4	18.6	15.9	16.2	18.7	17.2	17.5
5th "	18.5	17.6	17.8	18.4	18.6	16.5	17.3	20.1	17.6	17.2
6th "	17.1	16.5	18.0	16.2	19.8	18.0	19.0	17.5	17.2	16.5
7th "	16.9	17.4	16.4	16.7	18.8	17.3	18.1	18.1	16.6	16.2
8th "	13.9	14.3	13.0	16.4	15.4	15.1	17.2	17.4	16.0	14.2
9th "	13.5	14.9	14.0	14.7	11.1	17.0	19.0	17.9	15.9	16.6
10th "	16.6	15.8	15.2	14.8	16.5	17.4	18.7	17.0	15.9	15.9
11th "	18.5	16.9	16.1	16.5	15.0	15.7	17.2	16.3	13.8	16.9
12th "	19.3	15.1	18.6	18.1	17.2	15.7	20.6	17.3	15.9	15.2
13th "	21.7	19.3	19.7	21.5	19.1	16.9	22.3	20.2	16.7	18.8
14th "	20.5	21.0	20.4	20.9	19.1	15.5	17.7	19.5	17.4	18.7

TABLE No. V.

THE AMOUNT OF FEED REQUIRED TO PRODUCE ONE POUND OF INCREASE WITH EACH STEER, EACH PERIOD (10 DAYS), AND THE AVERAGE AMOUNT IN EACH SERIES.

	FEED—CORN-AND-COB MEAL.					FEED—CORN MEAL.				
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
1st Period	3.00	4.42	3.74	30.20	2.63	19.00	9.67	3.30	8.55	6.05
2d "	No gain.	7.88	17.50	22.20	9.05	6.89	4.48	No gain.	19.20	No gain.
3d "	3.33	27.20	6.36	4.00	3.91	5.28	5 95	No gain.	3.54	3.10
4th "	31 60	4.49	8.75	30.20	No gain.	7.00	5.40	2.63	6.43	4.97
5th "	No gain.	No gain.	33.80	No gain.	7.36	29.40	5.92	5.97	20.00	6.04
6th "	2.47	4.93	6.92	4.11	10.00	4.69	No gain.	6.44	10.00	29.40
7th "	15.30	3.86	6.04	6.95	4.36	6.00	3 22	7.73	3.96	4.90
8th "	No gain.	17.12	7.28	11 77	11.00	6.35	10.60	9.28	6.60	5.32
9th "	3.49	7.25	5.80	5.60	4.07	4.86	6.00	3.96	20.00	10.60
10th "	No gain.	15 70	8 00	No gain.	No gain.	35.40	No gain.	34.60	No gain.	27.00
11th "	33.80	33.60	34 40	5.37	2.58	No gain.	8.00	No gain.	5.87	11.00
12th "	2 61	2.58	4.08	18.00	10.00	5.40	38.80	3.62	13.80	4.34
13th "	No gain.	8 24	No gain.	5.47	No gain.	11.93	8.56	14.53	10.95	6.50
14th "	5.80	4.24	3.34	4.46	3.37	3.75	5 00	7 17	5 20	4.47
Amount of feed for 1 lb. of increase of each steer	8.43	6.49	7.23	8.33	6.68	7.47	9.16	8.17	8.16	6.98
Av. amount of feed for lb. of increase in each series			7.32					7.95		

TABLE No. VI.

A COMPARISON OF THE RESULTS OBTAINED IN EACH SERIES IN DEFINITE PERIODS OF TIME.

	Numbers 1, 2, 3, 4, 5. FEED—CORN-AND-COB MEAL.							Numbers 6, 7, 8, 9, 10. FEED—CORN MEAL.						
	Total feed.....	Total increase.....	Feed consumed for each 100 lbs. live wt.	Feed for 1 lb. of increase.....	Gain per cwt. of steer.....	Average daily feed of each steer.....	Average daily gain of each steer.....	Total feed.....	Total increase.....	Feed consumed for each 100 lbs. live wt.	Feed for 1 lb. of increase.....	Gain per cwt. of steer.....	Average daily feed of each steer.....	Average daily gain of each steer.....
1st Period.....	788	197	18.9	4.00	4.8	15.76	3.94	752	114	17.5	6.6	2.7	15.04	2.28
2d "	695	48	15 3	13.7	1.1	13.18	.96	618	18	13.9	34.3	.4	12.36	.36
Totals and averages for 20 days.....	1447	245	17.0	5.9	6.	14.47	2.45	1370	132	15.7	10.4	3.1	13.70	1 32
3d "	685	135	15.6	5.1	3.1	13.7	2.70	674	83	15.3	8.1	1.9	13.48	1.66
4th "	822	65	17.8	12.6	1.4	16.44	1.30	775	165	17.1	4.7	3.7	15.50	3.30
5th "	824	20	18.2	41.2	.4	16.48	40	825	95	17.7	8.7	2.1	16.50	1.90
6th "	813	170	17.5	4.8	3.7	16.26	3 40	837	80	17.6	10.5	1.7	16.74	1.60
Totals and averages for 40 days.....	3144	390	17.4	8.1	9.	15.72	1.95	3111	423	16.9	7.4	9.7	15.55	2 11

7th "	827	146	17.3	5.6	3.1	16.54	2.92	838	179	17.2	4.7	3.7	16.76	3.58
8th "	711	29	14.6	24.5	.6	14.22	.58	803	111	16.	7.2	2.2	16.06	2.22
9th "	674	135	13.6	5.	2.8	13.48	2.70	887	135	17.3	6.6	2.6	17.74	2.70
10th "	792	—10	15.8	No gain.	No gain.	15.84	—.20	861	25	16.6	No gain.	No gain.	17.22	—.50
Totals and averages for 40 days.....	3004	300	15 3	10.	6.4	15.02	1.50	3389	400	16.8	8.5	8.4	16.94	2.00
11th "	838	110	16.6	7.6	2.2	16.76	2.20	827	65	16.	12.7	1.2	16.54	1.30
12th "	922	210	17.7	4.4	4.1	18.44	4.20	896	135	16.9	6.6	2 6	17.92	2 70
13th "	1081	45	20.2	24	.8	21.62	.90	1025	105	19.	9.8	1.9	20.50	2.10
14th "	1129	280	20.4	4.	5.2	22.58	5.60	994	200	17.8	5.	3.6	19.88	4.00
Totals and averages for 40 days.....	3970	645	18.8	6 2	12.9	19.85	3.22	3742	505	17.4	7.4	9.7	18.71	2.52

For convenience in comparing the general results obtained in the two series, the following summary has been prepared. The figures in the vertical columns indicate pounds in every case: —

	Total feed	Total Gain.	Meal consumed for each 1 lb. of increase.	Average daily feed.	Average daily gain of each steer.	Gain per cwt. of each steer.	Average Gain.
Steers No. 1, 2, 3, 4 and 5. Feed—Corn-and-cob Meal.	11565	1580	7.32	16.52	2.25	39	316
Steers No. 6, 7, 8, 9 and 10. Feed—Corn Meal.	11612	1460	7.95	16.59	2.08	35	292

The above summary shows strikingly the advantages of the corn-and-cob meal over the clear corn chop. In every particular the advantage is in favor of the steers which were fed corn ground with the supporting cob. These steers consumed fewer pounds of feed daily and totally than those fed corn chop, making at the same time a larger gain per steer, and per hundred weight of steer, and at a considerable less cost of feed. In fact, this experiment seems to show quite conclusively *that a pound of corn cob when ground and fed to steers with the corn on which it grew is worth more than a pound of meal made from corn alone.*

This difference in the value of corn meal and corn-and-cob meal may be shown in another way, as follows:—

11,565 pounds of corn-and-cob meal give 1,580 pounds of increase.

11,565 pounds of corn meal give 1,454 pounds of increase.

The question of the proportion of corn to cob in the corn-and-cob meal used in the above experiment is of importance in the above connection. The average result of a large number of weighings made during the progress of

the experiment was 18 pounds of cobs to each 100 pounds of corn in the ear. It is needless to say that this eighteen per cent of the yield of all Kansas cornfields, if the teachings of this experiment are to be relied on, is of very great importance to the agricultural interests of the State. The difference between the value of a bushel of corn ground with its cobs, and a bushel of shelled corn as shown by this experiment is seen in the following statement:—

1 bushel (70 lbs.) corn-and-cob meal give 9.56 pounds of increase.

1 bushel (56 lbs.) corn meal give 7.04 pounds of increase.

Or, to put this fact in another form: if the value of this increase was 5¼ cents per pound (the price at which the steers were sold), the value of the bushel of corn-and-cob meal was fifty cents plus a small fraction, and the value of the bushel of corn meal was something under thirty-seven cents—a difference in favor of corn-and-cob meal amounting to a trifle over thirteen cents per bushel. Moreover, the steers to which the cob meal was fed were "off their feed" much less often than those receiving clear corn meal, and apparently they digested their food much better than those receiving the more concentrated grain. On this last point, however, I have no accurate data, and can only give the opinion freely expressed by those who were in position to notice the behavior of both sets of steers.

The cost of grinding this cob will vary with circumstances, but in any case a great outlay of power will be required. I am only approximately accurate in saying that with the power mill, operated with a ten-horse-power engine now in use, we can grind to the condition of fine "chop" about 25 bushels of shelled corn or 12 bushels of 70 pounds each of corn in the ear, in one hour. Other machines might give different results, and, under different circumstances, as where wind or water power was available, the actual cost of grinding the cob might not be great.

I am glad to be able to say that the experiment here detailed is being repeated the present season, under somewhat more favorable circumstances, and that the question of the value of cob meal to hogs is also under examination at the College Farm.

STALL-FEEDING.—The question whether fattening cattle may be profitably tied up and fed in a suitable building, is an open one in Kansas, where "stall-feeding" is quite unknown in practice. I wish here to call attention to the facts bearing upon this point, as furnished by this experiment:—

1. The mere practical results of feeding the ten steers were certainly very satisfactory, not to say remarkable. The gain of 37 pounds per cwt., and total gain of 304 pounds per head, in 14 weeks of feeding, Kansas feeders will recognize as indicating better results than those usually obtained in the ordinary "feed lot." The average daily gain, and the cost in feed of each pound of increase, are alike satisfactory, considered from the standpoint of the producer. That these results are largely due to the facts that the steers were tied up in comfortable quarters and fed regularly upon ground feed, can scarcely be questioned. Certainly the favorable outcome of this feeding trial establishes a strong presumption in favor of stall-feeding.

2. The great expense of buildings is frequently urged as an insuperable obstacle to stall-feeding in the West. The cost of the building in which our ten steers were fed was exactly $105.37. This building—a plain battened board shed 14x40 feet, with board roof—will, with ordinary usage, last at least a dozen years. It may also be used to advantage in many ways when not occupied by fattening animals. I am confident that I do not underestimate the cost of buildings when I say that one dollar per head will fully cover the expense of each steer on account of the barn-room he occupies.

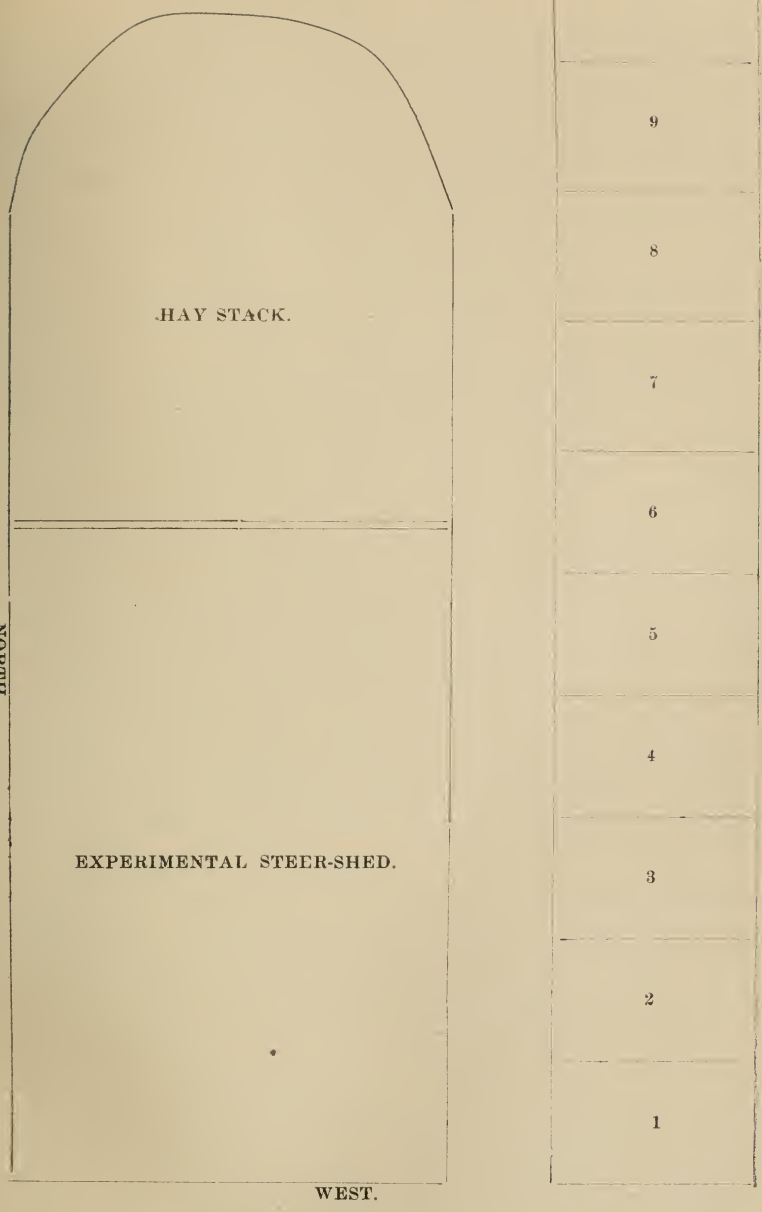
3. The increased labor in caring for cattle confined in a building as compared with the labor required in handling

them in the "feed lot" is often cited against the former practice. The care of the ten experimental steers under consideration occupied the time of one man about three hours daily; but besides the usual feeding, watering, bedding, etc., this labor involved such unusual work as weighing feed and recording weights, besides weighing the animals themselves at regular periods. In favor of stall-feeding, too, it must be said that all of the valuable manure made, may be easily saved to the cultivated part of the farm, instead of being left to waste in an uncultivated feed lot. I am confident that upon every Kansas farm the cost of cleaning out the cattle stalls daily, and hauling the manure afield is more than compensated for by the value of the manure thus saved. This saving of the manure, and the diminished waste of feeding where cattle are confined to stalls will go far towards paying for the increased cost of handling fattening cattle by this method.

4. It is often asserted that range cattle and those unaccustomed to close confinement will not thrive when restrained within the narrow limits of a stall. It is said that such cattle will pine and mope frequently for weeks together, meanwhile eating barely enough to sustain life. Our experience with these experimental steers runs quite counter to this view. These steers when first placed in confinement were the most untamed and untamable of half-wild range cattle. They could only be tied up by the sheer force of half dozen men, and when at first confined would dash themselves against the partitions and the sides of the building in paroxysms of terror. For about two days after their confinement, they ate but little for the obvious reason that ground corn was an unfamiliar feed to them; but after this time, the only difficulty experienced was in preventing them from over-eating. They devoured greedily all food that was placed before them, while the operations of feeding, bedding and cleaning out the stalls were attended with no special difficulties, so far as the cattle were concerned. Within a week from the time they were

first tied up, no difficulties were experienced in leading them to water or to the platform scales—distant several rods from the feed shed—on which they were weighed.

I am by no means clear in my own mind that the stall-feeding of cattle can be profitably followed in the West, but am abundantly satisfied that many of the reasons commonly urged against the practice are "notions" without foundation in fact. The question is one that can only be settled by that growing class of feeders who use the scales often, carefully estimating the cost of their operations.


HAY STACK.
EXPERIMENTAL STEER-SHED.
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1
EXPERIMENTAL PIG PENS.

CORN-AND-COB MEAL FOR PIGS.

In a previous chapter of this report, the results obtained in feeding fattening steers corn-and-cob are detailed. At the time when that experiment was undertaken it seemed to me to be useless to attempt a feeding experiment with pigs, using corn-and-cob meal as the feed. Further experience, however, showed that pigs will eat corn-and-cob meal when the cob is properly prepared, and they will consume it nearly or quite as well as clear corn meal, wasting but little more in feeding than is ordinarily wasted where clear corn meal is used, and digesting it without difficulty. This fact seems to show that either the cob possesses a greater nutritive value than is usually assigned to it, or the simple stomach of the pig has greater digestive capacity than might be expected from theoretical considerations. In the experiment under consideration, ten pigs—almost exact yearlings—were employed. Of these, six were purely bred Berkshires and the remainder half and half Berkshire-Essex. They were, as a whole, a thrifty lot, and fairly uniform in all essential qualities. Substantially, the plan employed in my pig-feeding experiments of other years was adopted in this. The pigs were fed twice daily at as nearly as possible 8 A. M. and 5 P. M., and the constant endeavor was to give each pig exactly the amount of feed which it would eat and no more. The weight of each feed was taken, and a careful record made of the same. Each pig received water *ad libitum*. At the end of each week, a short time before the first feeding of the next week, all the pigs were weighed, and the weights recorded opposite the number of each animal upon the paper containing the record of the feed. The pigs were arranged in two series,—Nos. 1 to 5 and Nos. 6 to 10 inclusive—the first series receiving as feed the meal obtained

by grinding the whole ear of corn, including cob; while the second were fed exclusively upon corn meal. The experiment was begun on Nov. 21, 1884, and ended Feb. 13, 1885, occupying a period of twelve weeks. The feeding was conducted in a series of "pens" erected for the purpose. These pens were each about eight feet square, the system ranging north and south. They were rather more than half roofed, and the entire series, except Pen 10, was protected on the north by the experimental steers' shed and by a hay stack ranging parallel with the pig pens. These pens, although kept constantly supplied with an abundance of clean straw, were wholly insufficient for ordinary shelter and protection, to say nothing of the comfort of the pigs during such an unusually severe winter as that just passed. The pigs suffered almost constantly from the terrible cold. The result of this insufficient shelter is seen in the greatly increased cost in feed of each pound of increase as compared with the increase obtained in previous years, with animals kept in comfortable quarters. Thus, in the pig-feeding experiment made two years ago (see Report of Experiments, 1883, p.7), the pigs kept in the warm barn gave a pound of increase for each 4.76 lb. of corn consumed, while, in the experiment under consideration, the corn-fed pigs required 6.7 pounds of corn for each pound of gain.

I am glad to be able to say that the necessity for performing our experimental work in temporary and inconvenient sheds will not exist after the present year; our State Legislature having recently appropriated $4,500, to be used in the construction of an experimental barn upon the College Farm.

As before stated, these pigs to which the corn-and-cob meal was fed consumed their rations almost, if not quite as quickly and with as great a show of appetite as those receiving the clear corn meal. During about the third and fourth weeks, when the sameness of diet had measurably blunted the appetites of the pigs, a disposition to pick out

the particles of corn from the coarse pieces of cob was manifest. With feed of more uniform fineness, and with greater care in apportioning the feed, this difficulty was not felt.

For the most part, the pigs received meal in the ordinary condition, without admixture with water; but during the prevalence of the greatest cold, the feed in both series was mixed with warm water, giving it the consistence of a thick mush.

In the tables given below, the principal results of the experiment are given. In Table No. I., the facts are grouped with reference to each animal; while in Table No. II., the results are given in definite periods of time.

TABLE No. I.

THE RESULTS OBTAINED WITH EACH PIG, IN POUNDS, TOGETHER WITH THE TOTAL AND AVERAGE RESULTS.

	No. of pig.	Wt. of each pig at beginning of exper't.	Weight of each pig at end of experiment.	Gain.	Gain per cwt.	Feed consumed (lb.)		Feed (lb.) consumed or each cwt. of pig.		Feed(lb.) for 1 lb. of increase.	
						Corn meal.	Corn-and-cob meal.	Corn meal.	Corn-and-cob meal.	Corn meal.	Corn-and-cob meal.
FEED—CORN-AND-COB MEAL.	1	207	329	212	58.9		777		289.9		6.37
	2	164	279	115	70.1		727		328.2		6.32
	3	191	318	127	66.0		694		272.7		5.46
	4	181	278	97	53.6		689		300.2		7.12
	5	222	318	96	43.2		732		271.1		7.62
Totals.....		965	1522	557	——		3619		——		——
Averages.....		193	304.4	111.4	57.7		723.8		291.0		6.50
FEED—CORN MEAL.	6	172	297	125	72.6	770		327.0		6.16	
	7	180	328	148	81.1	798		314.2		5.39	
	8	231	344	113	48.9	777		270.2		6.88	
	9	250	380	130	52.0	880		279.4		6.77	
	10	190	246	56	29.5	607		278.4		10.84	
Totals.....		1023	1595	572	——	3832		——		——	
Averages....		204.6	319	114.4	55.9	766.4		292.7		6.7	

TABLE No. II.

THE RESULTS OBTAINED EACH WEEK IN BOTH SERIES, TOGETHER WITH THE TOTAL AND AVERAGE RESULTS.

	Pens 1, 2, 3, 4, 5. FEED—CORN-AND-COB MEAL.				Pens 6, 7, 8, 9, 10. FEED—CORN MEAL.			
	Feed (lb.)	Gain (lb.)	Gain (lb.) per cwt. of pig.	Feed (lb.) for 1 lb. of increase.	Feed (lb.)	Gain (lb.)	Gain (lb.) per cwt. of pig.	Feed (lb.) for 1 lb. of increase
Nov. 28, end of 1st week	339	50	5.18	6.78	341	88	8.60	3.87
Dec. 5, " " 2d "	313	70	6.90	4.47	307	78	7.03	3.93
" 12, " " 3d "	321	57	5.25	5.63	352	57	4.79	6.18
" 19, " " 4th "	313	28	2.45	11.18	316	37	3.20	8.54
" 26, " " 5th "	315	48	4.10	6.56	340	31	2.43	10.97
Jan. 2, " " 6th "	315	57	4 68	5.53	338	42	3.19	8.05
" 9, " " 7th "	308	52	4.08	5.94	310	63	4.66	4.92
" 16, " " 8th "	291	29	2.19	10 03	331	21	1.48	15.76
" 23, " " 9th "	292	44	3.24	6.64	292	29	2.02	10.07
" 30, " " 10th "	306	42	3.00	7.29	332	77	5.24	4.31
Feb. 6, " " 11th "	277	65	4.50	4.26	325	77	4.91	4.22
" 13, " " 12th "	229	15	1 00	15.13	248	-28	—	—
Totals	3619	557			3832	572		
Averages	301.6	46.4	57.7	6.5	319.3	47.7	55.9	6.7

The summary of the facts of the experiment given below will aid in a comparison of the results obtained. The figures in the vertical columns refer to pounds or decimals thereof in every case:—

	Total Feed.	Total Gain.	Meal consumed for each pound of increase.	Average daily feed of each pig.	Average daily gain of each pig.	Gain per cwt. of each pig.	Average gain per pig.
Pigs No. 1, 2, 3, 4 and 5. Feed—corn-and-cob meal.	3619	557	6.50	8.6	1.33	57.7	111.4
Pigs No. 6, 7, 8, 9 and 10. Feed—corn meal.	3832	572	6.70	9.1	1.36	55.9	114.4

The facts furnished by this experiment strongly support the deductions made from the experiment in feeding steers (see pages 16 and 17 of this report), detailed in another chapter. Of these steers, I said: "In every particular, the advantage is in favor of the steers which were fed corn ground with the supporting cob * * * In fact, this experiment seems to show quite conclusively *that a pound of corn cob, when fed to steers with the corn with which it grew, is worth more than an equal amount of meal from corn alone.*"

This statement is almost exactly true of these experimental pigs; the only exception being in the total gain—an immaterial point—which was slightly less with the corn-and-cob-fed pigs than with those receiving corn meal.

The somewhat extraordinary results given by Pig No. 10 as shown in Table No. 1. are probably largely due to the imperfect protection which he received from the winds. (See diagram, page 21.) Although when put up he was not inferior in appearance to No. 2 or No. 4, he yet fed poorly, and seemingly was almost constantly suffering from the severe cold weather which prevailed during much of the time covered by this experiment. If, as has been suggested, No. 10 be thrown out, then the results will show a trifling advantage for the pigs receiving clear corn

meal. The average cost of a pound of increase of the corn-fed pigs being 6.23 ℔. of meal to 6.5 ℔. with the pigs getting corn-and-cob. But the unusual results obtained in the case of No. 10 are doubtless chargeable to other causes than an ill-sheltered pen; and if we throw out the poorest feeder in one series, it would seem only fair to discard the poorest feeder in the other series, in which case the cost in feed of a pound of increase (6.26 ℔. in series No. 1 and 6.23 ℔. in series No. 2) is almost identical in the two sets.

The very close analogy between the results of this experiment and those obtained with steers fed under similar circumstances as to feed, one year ago, are shown in the following parallel statements: Thus with the steers fed 1 bushel (70 ℔.) corn-and-cob meal gave 9.56 pounds of increase (see p. 17 this report.); while with the pigs 1 bushel (70 ℔.) corn-and-cob meal gave 10.76 pounds of increase: and with the steers again 1 bushel (56 ℔s.) corn meal gave 7.04 pounds of increase while with the pigs 1 bushel (56 ℔.) of corn meal gave 8.35 pounds of increase. The fact that the pigs were fed during the late severe winter season, while the steers were fed during the comparatively mild winter of 1883-4, is a sufficient explanation of the near approach of the cost of a pound of increase of the pigs to that of the steers. That an animal possessing the comparatively simple digestive apparatus of the pig is able, almost equally with the ox, possessing complex and extended digestive machinery, to use the cob as feed, would seem to indicate that it exerts something more than a mere mechanical influence in nutrition.

THE PORK PRODUCT OF A HALF ACRE OF ALFALFA.

The writer has, more than once through the public press, urged upon Kansas farmers the importance of the cultivation of the perennial grasses and clovers as summer feed for hogs. The "hog pasture" or "hog lot" is, in too many cases, selected solely because it is furnished with shade and water. It is almost certainly a very limited field, considerations of economy in fences, and not the size of the, herd, generally fixing its area. As a result of this mistaken economy, it is as a rule a noisome, disease-breeding "pen" on a somewhat enlarged scale, and not a pasture-field in any proper sense. The "hog pasture" should be not one whit less a pasture than the summer feeding-ground of cattle. Both hogs and cattle, the one no less than the other, need pure water and succulent herbage and clean quarters; and it is at least doubtful if cattle pay as liberally for these as swine. An item of general experience in this connection may be of interest: During nearly six months of the past season a herd of breeding sows, some seven in number, with a variable number of store hogs, were with cattle kept in a pasture-field, receiving no other feed than the orchard-grass, clover and alfalfa furnished by the field. Upon herbage alone, these hogs kept in perfect health and in heavy flesh. Ample summer pasturage for our hogs will ensure to the owner cheaper pork of better quality than is now in general practice made, and to the herds an immunity from disease which they have not heretofore enjoyed. Of all the grasses and clovers suitable to this latitude, alfalfa is one of the most useful, if not the most useful, for hog pastures, on account of its perennial habit, and because it is but slightly affected by drouth, furnishing during a long season an enormous quantity of feed of the best

quality. With the object of furnishing accurately-determined facts regarding the value of alfalfa to the hog-raiser, the experiment detailed below was undertaken.

In the spring of 1884 an exact half acre, occupied by a dense growth of alfalfa seeded one year before, was secured by a substantial fence. The original plan was to keep upon the ground a sufficient number of pigs to consume the growing alfalfa without the addition of grain, avoiding waste on the one hand or overpasturing on the other. The plan involved, further, the weighing of the pigs about once each month, in order that the rate of development might be noted.

On May 12th thirteen six-months-old shoats were quartered on this half acre. Of the thirteen pigs, eight were Essex-Berkshires and the remaining five pure-bred Berkshires. At this time the alfalfa was about ten inches high, forming a dense growth which occupied every foot of the ground. In a concise statistical form, the facts of this experiment may be stated as follows:—

May 12 thirteen pigs turned in alfalfa, total weight	1,225 lb.
June 10 " " weighed	1,254 "
Gain in 29 days	29 lb.

It was apparent that the field had been overstocked. Thirteen shoats, averaging in weight nearly a hundred pounds each, had wants beyond the capacity of a half acre, even of alfalfa, to supply. As the pigs had depastured the ground very closely, it was determined to feed a small daily ration of corn. This daily feed—two pounds of corn in the ear, per pig—was fed through the remainder of the season, except during half a month, when three pounds were fed.

June 10th, three pigs were removed, leaving 10 pigs in the field weighing	1,079 lb.
July 10th the 10 pigs weighed	1,315 "
Gain in 30 days	236 lb.

The pigs were next weighed Aug. 8th, their weight at this time being 1,470 lb.

Gain from July 10th, 29 days, 155 lb.

During July and the early part of August, dry weather prevailed so that the alfalfa did not make the rapid growth shown earlier in the season. For this reason, on Aug. 16th the 10 pigs were weighed and four of these withdrawn from the experiment.

August 16th the weight of the 10 pigs was 1,488 lb.

Gain from August 8th, 8 days 18 lb.

August 16th, weight of the 6 pigs remaining 896 lb.
September 11th, " " " " 1,047 "

Gain from August 16th, 26 days 151 lb.

September 11th, weight of six pigs 1,047 lb.
October 13th (end of exp't), weight of 6 pigs 1,175 "

Gain from September 11th, 32 days 128 lb.

The pigs were actually kept in the alfalfa pasture some two weeks after the last weighing. About the end of October the pigs made their escape from the alfalfa field, joining the general herd, from which it was found difficult to separate them; so that no attempt was made to weigh them. By this accident, the experimental half acre fails to get credit for the support which it gave six pigs during these two weeks. In the following table, the results of the experiment are given in detail: —

	No. of pigs.	Average weight of pigs (lb.)	Gain (lb.)	Total daily gain.
May 12th to June 10th	13	95	29	1.00
June 10th to July 10th	10	119	236	7.86
July 10th to Aug. 8th	10	139	155	5.34
Aug. 8th to Aug. 16th	10	148	18	2.25
Aug. 16th to Sept. 11th	6	162	151	5.80
Sept. 11th to Oct. 13th	6	185	128	4

The half acre of alfalfa with a small daily ration of corn gave —

Support during 154 days to rather more than nine pigs having the average weight of 140 lb.

It yielded daily 4.65 lb. of pork.

" " a total of 717 lb. of pork.

The total amount of corn—in the ear—consumed by these pigs from June 10th, when corn was first fed, to the time when the experiment was brought to a close, amounted to 2,146 pounds, rather more than two pounds daily for each animal during the time when corn was fed. Of this, 18 per cent, or 386 pounds, consisted of cob. Deducting this, and we have 1,760 lb., the amount of corn actually used. The value of this corn can only be approximated. In my pig-feeding experiments of 1883, the pigs fed in the warm barn gave one pound of increase for each 4.76 pounds of corn; and those kept in the open yard required 5.93 pounds of corn for each pound of gain (See report for 1883, p. 7). Taking the mean of these figures —5.34—as the number of pounds of corn required to make a pound of increase, in the experiment under consideration, and we have as the product of this 1,760 pounds of corn—discarding fractions—329 pounds of pork. Deducting this amount from the total amount of pork-yield of this half acre—717 pounds—and we have as the net yield of the half acre of alfalfa 388 pounds of pork.

When we reflect that the returns from this half acre came without plowing, seeding or harvesting, or, indeed, labor of any kind, except the trifling work involved in the daily feed of corn, the great value of alfalfa to the hog-raisers will be understood. Moreover, every swine-raiser will, I think, agree with me that the quality of the flesh produced by this green feed was really worth more, pound for pound, than the fat ordinarily produced by feeding wholly of constipating grains. The pigs fed thus upon green food were in the best possible condition to make the most of the corn fed in the subsequent "full feeding."

It may, I think, easily be shown that an acre of perennial alfalfa when fed off, as in the experiment, by pigs of good quality, will give a larger yield of pork than an acre of grain laboriously produced. Thus, the number of pounds of pork produced by an acre of alfalfa, according to the data furnished by the half acre under consideration, would be 776; while sixty bushels of corn (3,360 pounds), supposing, as before, that 5.34 pounds of corn produce one pound of increase in the pigs to which it was fed, would give a gain of 629 pounds. or 147 pounds less than the product of an acre of alfalfa.

Whether alfalfa is a sufficient feed for fattening hogs is a question which received no consideration in the experiment detailed, and no inferences bearing on that point can be safely drawn from it. The constant aim during the entire season was to consume without waste the alfalfa as it grew, while keeping the pigs in good store condition.

DEEP AND SHALLOW PLOWING AND THOROUGH CULTIVATION FOR CORN.

In my Report of Experiments for 1883, the details of an experiment in subsoiling corn ground were given. This trial seemed to show that the subsoiling was in every case a partial injury, every subsoiled plat giving a lower yield of corn than the average yield of those plats which were simply plowed to the ordinary depth of six inches. The subsoiling features of this experiment were repeated the past season on different ground, upon which, also, the practice of close and deep cultivation of corn was compared with superficial cultivation. For the purposes of the experiment, above referred to, ten plats, each one twentieth of an acre, were laid off in Field No. 4. The soil of this field is a strong clay of only moderate fertility. The field has been in cultivation for at least twelve years, receiving during this time at least three thorough dressings of farm-yard manure.

The general plan of these experiments is shown in the diagram on the following page. The ten plats range east and west continuously, except that every plat was separated from the two adjoining by a two-foot space, which was not cultivated. Each alternate plat was simply plowed to the depth of six and one half inches, while the plats separating these "nothing" plats received special treatment, as shown in the diagram.

The experimental ground was plowed May 19th, at which date the work, including the subsoiling, was finished. In the subsoiled plats, the subsoiler working to the depth of four inches, followed the stirring-plow which cut a six-and-half-inch deep furrow; so that the ground in the subsoiled plats was stirred to the depth of ten and half inches. The corn was planted in rows three and half feet

PLAN OF EXPERIMENT.

SIZE OF EACH PLAT, 1-20 ACRE.

EAST.

Plat A—plowed 6½ inches deep; subsoiled 4 inches deep.

Plat B—plowed 6½ inches deep.

Plat C—plowed 3 inches deep.

Plat D—plowed 6½ inches deep.

Plat E—plowed 6½ inches deep; subsoiled 4 inches deep.

Plat F—plowed 6½ inches deep.

Plat G—plowed 6½ inches deep; deep cultivation.

Plat H—Plowed 6½ inches deep; shallow cultivation.

Plat I—plowed 6½ inches deep; deep cultivation.

Plat J—plowed 6½ inches deep; deep cultivation.

NORTH.

apart, the corn plants standing about ten inches apart in the drills. The variety of corn employed was the medium sized "King Phillip."

Upon the plats G, H, I and K different methods of cultivating the growing corn were employed. These plats were cultivated — the ordinary one-horse cultivator being used —four times, at intervals of about ten days. At the first cultivation all plats were lightly dressed out, the cultivator passing twice in each row. At the subsequent operations, plats G and I were cultivated but once in a row, and then quite superficially, while in plats H and J the cultivator was made to pass twice in each row, very close to the rows of corn and to the depth of nearly five inches. In these last mentioned plats the ground was literally churned by the cultivator; and at each operation the implement brought to the surface great quantities of white fibrous rootlets torn by the implement from the corn plants.

The results of the experiment are clearly shown by the subjoined table: —

	Yield of plat—corn, (lb.)	Yield of plat—stalks, (lb.)	Yield per acre—corn, bushels (70 lb.)	Yield per acre—stalks, tons.
Plat A—plowed 6½ inches deep and subsoiled 4 inches	233	182	66.57	1.82
" B " " " "	213	132	60.85	1.32
" C " 3 " "	214	152	61.14	1.52
" D " 6½ " "	228	168	65.14	1.68
" E " " " " and subsoiled 4 inches	216	172	61.71	1.72
" F " " " "	211	128	60.29	1.28
" G " " " worked deep with cultivator	244	191	69.71	1.91
" H " " " " shallow " "	247	182	70.71	1.82
" I " " " " deep " "	243	179	69.43	1.79
" J " " " " shallow " "	246	184	70.29	1.84

SUMMARY.

	Average yield of plat, corn, (lb.)	Average yield of plat, stalks, (lb.)	Average yield per acre—corn, (lb.)	Average yield per acre—stalks (tons.)
Plats A and E—subsoiled	224.5	177.0	64.1	1.77
" B, D and F—nothing plats, adjacent subs'd plats	217.3	142.6	62 1	1.42
" C—plowed 3 inches deep	214.0	152.0	61.1	1.52
" B and D—nothing plats, adjacent plat C	220.5	150.0	63.0	1.50
" G and I—worked deep with cultivator	243.5	185.0	69.6	1.85
" H and J—cultivated shallow	246.5	183.0	68.1	1.83

A glance at the tables will show that neither of the specially-treated plats had any considerable advantage over those treated in the ordinary fashion. The fluctuations in the yield, as shown in the tables, may as safely be charged to slight differences in the soil of the different plats, or to errors which could not be guarded against, as to the particular treatment given the different plats. Had all of the plats received exactly the same treatment, I should have expected variations at least as great as those shown in the tables. The results of subsoiling, as shown here, agree substantially with those obtained one year ago in another field, where the subsoiled plats showed a slight loss as compared with plats adjoining, which were planted in the usual manner, both showing that very deep tillage is not advantageous, even upon strong clay lands, during favorable seasons. In a season of drouth, different results from these might be expected.

The experiment seems to show, too, that the methods usually reckoned injurious, as, for example, shallow plowing and very deep and close cultivation of tall, well-grown corn had no unfavorable influence upon the crop. It seems to be sufficient in a Kansas cornfield of ordinary productiveness that the ground shall receive moderate cultivation, and be kept free from weeds, as, in the case of these experimental plats; and, with these conditions complied with,

the soil and the season will do the rest. After our soils, from long continued and injurious cultivation, have become physically altered for the worse, and have parted with much of their present nitrogenous stores, we may expect that the corn crop will respond more readily to variations in its culture and general treatment. As it is, the cheapest method—the one least expensive in labor—is generally the most valuable to our farmers, and the question of the relative cheapness of methods is not one that may be determined by an experiment—conducted as an experiment must be—on a small scale.

FARM-YARD MANURE APPLIED TO MILLET GROUND.

In my Report for 1883 (p. 19), the details of an experiment with farm-yard manure applied to corn ground were given. In this experiment it was shown that the application of manure at the rate of twenty-eight loads per acre had given no increase in the yield of grain, but a very considerable increase in the yield of stalks. The plats treated to manure (plats M and N) in 1883 were, without any further application of manure, or other special treatment, plowed late in the following spring, and seeded to the common millet so generally cultivated in this State as a hay crop. The millet was sown January 13th, harvested August 22d, and hauled to the barn in the condition of excellent hay on August 25th. Below is given the yield of the manured plats, and, for comparison, the product of the adjacent "nothing" plats which received no application of manure: —

	Yield of plat in hay, lbs.	Yield per acre, tons.
Plat L—Nothing	240	2.4
" M—Manured	360	3.6
" N—Nothing	200	2.0
" O—Manured	310	3.1
Manured plats M and O, average	335	3.35
Nothing plats L and M, average	220	2.2
Increased yield of manured plats	115	1.15

The lesson taught by this simple trial is, like most agricultural truths, a very old one, but one nevertheless that is well worth repeating. That manure should prove indifferent or even injurious to crops the first season after its application, while acting with great efficiency during the second, third, fourth or even fifth year, agrees with the general experience of many years upon the College Farm.

EXPERIMENTAL GRASSES AND CLOVERS.

In my report for 1883, a full statement of those facts likely to be most serviceable to the practical man is given regarding those grasses and clovers which in an experience of nearly a dozen years upon the College Farm have proved to be fairly reliable in general cultivation. In that report the great value of orchard-grass, alfalfa and red clover for central Kansas was particularly emphasized. The opinion then expressed we have since seen no reason to change, and this view, judging from the reports of experiences given by farmers in the local press of the State, Farmers' Institutes and in the Reports of the State Board of Agriculture, is being rapidly confirmed in general practice. While it is true that other sorts like oat-grass, Kentucky blue-grass and timothy are, in certain soils and under certain conditions, even more valuable than those mentioned above, it is yet true that they are suited to a greater number of wants and conditions than any that we have experimented with. In reply to the objection that the number given is extremely limited, it may be said that the number of grasses and clovers finding popular favor is in any section extremely limited. In New York and the Middle States, timothy, clover and a small amount of red-top are almost the only perennial forage plants of recognized value in general practice. In Illinois, Kentucky and Missouri, Kentucky Blue-grass, timothy and red clover are with much smaller areas of orchard-grass and red-top in general cultivation. Nor is it likely that this condition of things in respect to the grasses will be soon changed. Farmers, as a class, are not apt at drawing nice distinctions; so that those few sorts which answer to the rougher general requirements of the farm are certain to obtain general favor. However, as our agriculture becomes more

diversified, an increased demand is certain to arise for varieties whose value is limited to a few purposes. With the object of adding to the number of our agricultural grasses and clovers, we have, for a number of years, cultivated in alternate plats, and, with increased experience with them, on larger areas, sorts not generally cultivated in Kansas, or those whose qualities are not generally known. Below is given our recent experience upon the College Farm with some of these less-known varieties:—

Alfalfa (*Medicago sativa*). So far as the College Farm is concerned, this variety has long since passed the experimental stages of its cultivation. We have cultivated it upon almost every kind of soil and with unvarying success since 1875. (For a full statement of our methods of cultivating Alfalfa and the results obtained, the reader is referred to page 33 of my Report of 1883).

Something of the value of Alfalfa for a particular purpose is shown in another chapter of this Report (see page 29). Nevertheless, many reports of more or less complete failures made by painstaking farmers came to me from widely different sections of the State. I am inclined to think that the cause of these failures is to be found in the character of the subsoil in which the Alfalfa was grown. Impervious or barren subsoils are equally to be avoided in the cultivation of Alfalfa, and, where these are suspected, they should first be brought into "condition" by the use of the subsoiler in one case and manure in the other.

Annual Clover — or Scarlet Italian Clover — (*Trifolium incarnatum*). In April, a plat of ground about three rods square was sown with this sort, the seed having been obtained from a seed-house in Georgia. This seed germinated abundantly and early in the season; the plants made a fairly vigorous growth. Later, the summer heats seemed to check its growth severely, so that at no time was it able to keep pace with the growth of weeds which came up in the plat. At no time did it make an equal growth with the Red Clover (*T. pratense*), seeded the

same season, which grew near by. All of the plants were dead before October 1st.

Bermuda grass (*Cynodon dactylon*). This variety I have grown on a small area something over three years. During this time, it has made a feeble, hesitating growth, never spreading much beyond the limits of the ground originally assigned to it. In my report of last year I said of this grass: "Of all the 'tame grasses,' it is latest to appear in the spring, and the lighest frost cuts it off level with the ground. Until the hot weather of June had set in, our Bermuda grass showed scarcely any sign of life and growth. But even then the amount of feed which it furnishes is quite insignificant. Moreover, our stock of all kinds showed no great fondness for it, leaving it always for Orchard-grass growing near by." The winter of 1883-84 completely killed our Bermuda grass, a sort which possesses not one quality of real value to Kansas farmers.

Johnson grass (*Sorghum halapense*). This grass we have had in cultivation for three years with no satisfactory results, if we consider the subject from the standpoint of the agriculturist During each of the three winters last past, it has severely winter-killed—apparently totally—the grass plat maintaining its continuous existence, it would seem, from a few scattered seeds which had found a lodgement beneath masses of rowen and stubble. Moreover, the first frosts of fall cut it level with the ground. These reasons alone seem to justify the worthless character given it in previous reports; but, when we add to this, the fact that this grass has never with us made its appearance above ground much before the first of June, when orchard-grass, Clover and Alfalfa are ready for the scythe; that the hay which it yields is coarse, woody and not much relished by stock,—there would seem to be no question of its worthlessness to this section of the State. In those sections in which this grass does not suffer from severe winters, and where the more valuable tame grasses cannot be

grown, we understand that Johnson-grass has considerable value; but in any locality where the better sorts of cultivated grasses and clovers may be successfully grown, it has no agricultural value.

Tall Meadow Oat-Grass (*Avena elatior*). This grass we have grown in the field upon a considerable scale for three years, and with uniformly satisfactory results. It is one of the earliest grasses in the spring, being fully one week in advance of Orchard-grass, and it retains its bright green color far into the winter. Oat-grass gives a very large yield of hay, which I am bound to say is only moderately relished by stock. It endures moderately dry seasons without injury, and makes abundant early and late pasturage. In giving these facts, I think I have stated the principal points of advantage of Tall Meadow Oat-Grass.

On the other hand it seems to be quite exhausting to the soil on which it grows, so that its cultivation is not likely to prove satisfactory for a length of time except upon land of a good degree of fertility. Moreover, it is like Timothy in that it gives but little pasturage after mowing, and before the late fall rains have set in. I consider this sort well worthy of a trial on most Kansas farms, and shall expect to see its cultivation greatly extended.

Texas Blue-Grass (*Poa Arachnifera*). In the spring of 1884 I obtained from a gentleman in Texas a supply of small plants of the above named grass. These plants during the month of April were set out in rows each plant receiving about one square foot of ground. Nearly all of the plants survived transplanting, and, although a dense growth of purslane came up and occupied the ground between the plants, they grew and thrived from the first. This grass seems to promise much for the winter grazier, and to speak from my brief experience with it, it is greatly superior for use in this section of the State, to its near relative, Kentucky Blue-grass. It makes a very early and vigorous growth and it retains its peculiar purple green

color through the entire winter. Texas Blue-grass has a much coarser habit than the Kentucky Blue-grass, and apparently does not make the compact sod so characteristic of the common Blue-grass. Whether this grass will endure close cropping, and be able to withstand uninjured the peculiar exigencies of our climate, and the palatableness to live-stock of the pasturage which it yields, are matters of which I can speak only after further trial. At the present I can only say that Texas Blue-grass deserves a high place among our experimental grasses.

SHRINKAGE OF CORN IN THE CRIB.

The question, how much if any, corn loses in weight by evaporation or other causes, while remaining in the crib during the winter months was the subject of a test employed during the past winter. On November 1st, 200 lb. of corn in the condition of ears, was placed in a box which had been secured in a position near the center of an ordinary corn crib with a capacity of about six hundred bushels. The corn used was an early-ripening sort which had been ripe fully six weeks before it was husked. Although the corn was taken directly from the field to the box, it was in a condition of almost perfect dryness. Soon afterwards the crib was filled in which condition it remained until near spring when a portion of the corn in the crib was removed, never however in sufficient quantity to uncover the box.

On July 1st, exactly eight months from the time when the corn had been set aside, the box was opened and its contents found to be in good condition, but weighing only 187½ pounds. The two hundred pounds had lost by evaporation exactly twelve and a half pounds or rather more than six per cent.

It would seem from this that the farmer who carries his corn crop until spring in the hope of realizing higher prices thereby should be very sure of a six per cent increase in value; and, considering the inevitable losses from vermin and the elements, something more, if in the spring the corn realizes what it would have fetched in the fall.

Whether the loss is from the grain or the cob of corn I am unable to say positively, but from some recent experience had in weighing corn of different degrees of dryness, I am inclined to the belief that the loss is mostly from the cob.

WHEAT CONTINUOUSLY ON THE SAME GROUND.

For four consecutive years a measured acre of ground has borne crops of wheat, the land during this time receiving no manure or dressing of any kind. During each year since the first, the ground has been plowed soon after the removal of the wheat crop and generally a second plowing has been given the land early in September a short time before the wheat was sown. The soil is a strong clay of moderate fertility. The following table gives the results of the four years of continuous cultivation of wheat on this acre: —

	Yield of grain, bus.	Yield of straw, lbs.	Straw (lbs.) to pound of grain.
1880–81—variety, Early Red May	9.00	—	—
1881–82 " " " "	47.00	7,845	2.7
1882–83 " " " "	28.19	3,281	1.9
1883–84 " Zimmerman	37.00	4,525	2.03
Averages	30.29	5,217	2.3

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EXPERIMENTAL BARN OF THE STATE AGRICULTURAL COLLEGE.

REPORT

OF THE

PROFESSOR OF AGRICULTURE,

KANSAS STATE AGRICULTURAL COLLEGE.

EXPERIMENTS.

1885.

MANHATTAN, KANSAS:
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1886.

PREFACE.

The report herewith submitted has no higher ambition than to state clearly the facts of a year of experimental work done upon the College Farm. Not much attention is here given to underlying theories or to the opinions which reasonably enough might be formed of the facts stated, in the belief that the needs of practical agriculture lie in the direction of the multiplication of facts rather than principles, and that opinions, however well based, when acted upon under varying circumstances, are liable to mislead.

The facts here detailed will be likely to prove useful in just so far as they receive intelligent applications as the circumstances of farmers suggest. The unthinking adoption of experimental facts is as much to be deprecated as their thoughtless rejection. Circumstances of soil, climate, location and markets may give to experimental facts great value or make them worthless. Experiments at the most cannot be much more then suggestively useful; the experimenter may furnish facts for the farm, but he cannot do the farmer's thinking. The obvious inference from all this is that in a very considerable degree every farmer must be an experimenter — a truth having especial application in new counties having no historical agriculture.

To Regents Forsyth, Moore and Henshall, the Farm Committee of the Board of Regents, my acknowledgments are due for the constant interest they have shown in the work of the department; to W. Whitney, foreman of the farm; and to students of the College to whom much of the details of the experimental work, including the feeding and care of experimental animals, have been entrusted.

E. M. Shelton,
Manhattan, Kansas.

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THE COLLEGE BARN.

The subject of the frontispiece of this report is the College barn,— or rather system of barns,— designed in part for experimental uses, a considerable part, however, performing the functions of the general-purpose barn. The cut facing our title page shows the front and westerly exposure of a connected structure, built at two different times, as the result of appropriations made for that purpose during the legislative sessions of 1876–77 and 1884–85. That portion of the building having its greatest extension north and south was built in 1877; the annex placed at right angles to this — the experimental barn proper — was finished ready for occupation in December last.

The entire structure is placed in a side-hill, sloping towards the east, and having a variation from the horizontal of about three feet in fifty. That portion of the building first constructed was planned for a farm carrying out a system of mixed husbandry, in which the growth of grains and grasses with stock-raising have about equal prominence. The newer portion, that having its greatest extension in the direction east and west, was planned with especial reference to the wants of the farm in its experimental operations. However, in the description which follows, "the barn" will in every case have reference to the entire structure, as shown in the cut.

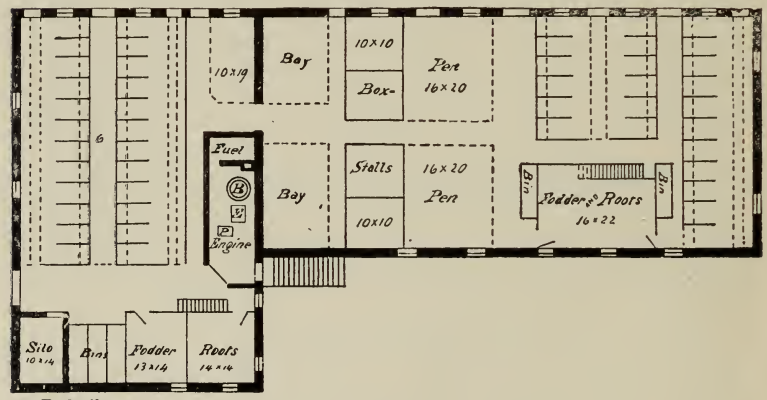
The old part of the barn is 97 x 48 feet, the new experimental portion 76 x 48 feet,— outside measurement in both cases. The building is of Manhattan limestone, put up in the best style of rubble work; all the arches of the doors and windows, all jambs, and, with the exception of one door in the upper story, all sills, are of cut stone. A basement 9 feet 6 inches in height underlays the entire build-

ing. The upper story is 16 feet high, measuring to the top of the walls.

The barnyard has an unobstructed eastern exposure,—an advantage which will be recognized by practical men. An abundant supply of excellent water may be had in this yard by digging to the depth of ten feet or less; and within five rods of the barnyard a perennial stream of spring water flows.

The writer is indebted to the professional skill of Prof. J. D. Walters, of the Department of Industrial Art, for the sketch from which the cut of the elevation and ground floor and basement plans referred to in this article, have been made, as well as for the drawings and specifications of the recently-constructed portion of the building; and for constant interest and oversight during the process of its construction.

BASEMENT PLAN.



B, boiler.
E, engine.
P, pump.

The basement of a farm barn, when properly constructed, is by far the most important and useful part of the structure; but when badly constructed, and especially

when ill ventilated and deficient in light, the basement is simply a pestilent, disease-breeding hole. All the objections to the basement are associated in some way with absence of good air and light; with these provided, all objections to the basement vanish. It is the most comfortable part of the barn to man and beast, and, under most circumstances, the portion costing least in construction, and that part of the building where animals are cared for with the least expenditure of labor.

WINDOWS AND VENTILATORS.

The above plan shows in very full detail the arrangement of the basement of the College barn. The very great number of doors and windows — the former indicated by blank spaces in the wall, the latter by the blank spaces divided longitudinally by a line — sufficiently attest the thorough lighting, and, to some extent, show the ventilation of this part. The windows are for the most part half sashes of usual size, hinged at the top so as to permit opening at will. Six ventilators — marked V in the plan of ground floor — establish a direct connection between the basement and outer air through cupolas on the roof. These ventilating shafts are made of inch flooring, with supporting joists at the corners; their sides are provided in suitable places with trap doors, through which hay or other fodder may be pitched to the basement. Being $3\frac{1}{2}$ feet on a side where they penetrate the ground floor, and 3 feet square at their upper extremities, these ventilators admit the passage of fodder without ever obstructing.

CATTLE STALLS.

The barn furnishes stall room wholly in the basement for fifty-one head of cattle, which might easily be increased nearly one half by the construction of stalls in the spaces marked "pen" and "bay." Each stall is 4 x 8 feet including the manger, 2 feet wide. At the rear of the stall

is a manure gutter 6 inches deep and 20 inches wide, and beyond the gutter in the single tier of stalls is a passage way 2 feet wide, on a level with the general floor. The mangers in all except box stalls consist of simply a foot-wide two-inch plank resting edgewise on the floor. This plank slides in cleats in the partitions, and these may be so adjusted that the space between the front of the manger and the gutter may be increased or diminished to suit the length of the animal using the stall. The grain boxes are made by simple partitions in the general manger. The stall partition next the alleys — the front of the manger — are not vertical, but slope towards the alley, eighteen inches out of the perpendicular; by which arrangement waste by animals while eating is largely prevented, the feed being caught as it falls from the mouths of the cattle and returned down the sloping partition to the manger. The box-stalls are 10 x 10, as shown in the engravings,— a satisfactory size in our experience, although a space of 8 or 9 feet by 10 feet, would answer nearly or quite as well. The space marked *Fodder* and *Roots*, if too great for the purpose suggested, may be partitioned and used as a box-stall or as storage room for calves.

FEED BINS.

The feed bins, five in number, are usually 3 x 12 feet. They are supported two feet from the floor, and have sloping bottoms, so that the feed slides readily to the front, where it is drawn out through a spout. Each bin communicates with the upper story by a hinged trap door set into the floor.

SILO, FODDER AND ROOT STORAGE ROOMS.

The considerable space given for the storage of fodder and roots may be used for other purposes than those named — as a hospital or as box-stalls or calf pens, for example — but in experimental work, these apartments will be found to be useful as storage rooms for specially-pre-

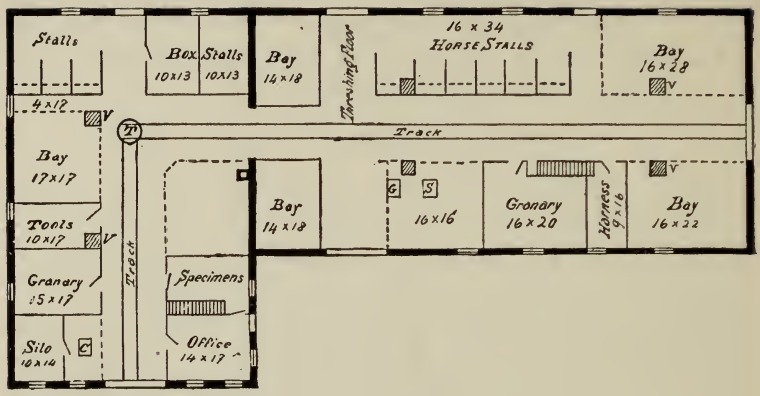
pared fodder and roots. The silo has for its walls solid masonry, well pointed, extending upwards to the main floor. The arrangement of the silo, feed bins, fodder and root storage rooms, with reference to convenience in feeding, has proved altogether satisfactory.

ENGINE AND FUEL ROOMS.

As a precaution against accidents from fire, the engine and fuel rooms have walls of masonary, as indicated in the plan. The fuel room is also partitioned off from the engine room by a stone wall. The total space given to the engine and its fuel supply room is 9x28 feet. The boiler and engine in use are of the vertical type, of nominal ten-horse-power. These, with the pump and other machines, are more fully referred to in another part of this report. The floor of the engine room is laid with dressed flagging stone, as is the main aisle in front of the feed bins and silo, and the alley extending past the engine room to the door at the rear. The space marked 10x19 at the rear of the fuel room is used for steaming and in other ways preparing experimental foods for pigs. A steam pipe from the boiler and a cold-water pipe lead to the steaming tank here located.

Outside of the matters of light and ventilation, the following are the considerations which have most influenced the arrangement of the basement: To place those parts in close proximity which are likely to be used in connection; as, for example, all space used for the storage of feed and the stalls in which the animals are fed; to place all stalls and tiers of stalls in direct communication with the barnyard, thereby giving ease of access and quick and easy riddance of manure. The hay bays extending to the basement floor have proved most useful; they are filled with the least possible labor from the floor above, and are very easily emptied in the process of feeding.

GROUND FLOOR PLAN.



C, feed cutter.
G, grinder.
S, sheller.
T, turn-table.
V, ventilator.

The main floor is about two feet above the ground level, and entrance is gained to it at the south end and west side of the old portion of the barn, and at the west end of the new portion, as shown in the plan. Earth embankments lead directly to the door-ways. These door-ways are 12 feet in width, and the main floors 13½ feet,—a space which ordinarily might be reduced one foot without lessening the usefulness of the barn.

MOW ROOM.

The bays with all the space over office, stalls, tool rooms, silo and granaries give the general storage room of the barn for hay and other fodder. This great area has been largely increased by flooring over a good part of the main gangway.

STALLS.

The horse stalls occupy a space 16x34 feet in the old portion of the barn, while in the newer portion three stalls occupy a space rather more than 13x17 feet. Each stall in the old barn is 5x9 feet, including manger and exclud-

ing the alley 7 feet wide at the rear. In the new barn, the width of the stalls is 4 feet. At the rear of the stalls is a blind gutter beneath the floor and covered by a plank on a level with it, which carries the liquid excreted to the drain at the rear of the cattle stalls in the basement.

OFFICE AND SPECIMEN ROOM.

In the office the records of the farm are kept. It is furnished with secretary and suitable chairs and other like furniture. The specimen room is designed as a secure place for the storage of specimens of farm and experimental crops. It is provided with suitable shelving and vermin-proof granaries. The blank space at the rear of the specimen room may, as convenience dictates, be used as a storage room for implements and machines, or it may be made to do service as a bay for hay or grain in the straw.

WATER SUPPLY.

The pump in the engine room is connected by an inch-and-half iron pipe with a never-failing well, located about 300 feet to the rear of the barn. It also connects, in like manner, with two cisterns, having a joint capacity of 350 barrels, which are located at either side of the main entrance to the newer portion of the barn. These cisterns are filled from the roof of the barn. From the pump, one pipe leads to the tank which supplies the boiler, and another to a 40-barrel reservoir, which is supported by the roof trusses at a point near the roof in the central part of the new barn. A steam pipe conveys steam from the boiler to this reservoir, by which means its contents may be raised to any desired temperature. From the reservoir, pipes lead to different parts of the barn, supplying stock with water and water for cleansing purposes as needed.

Upon the track indicated in the cut moves a car, having flanged wheels of the usual form. This track leads to the corn-cribs, located south of the barn, and upon it grain and hay are conveniently shifted.

The above description is, perhaps, sufficiently detailed for the purpose of most readers. A really useful barn is a thing of growth and amplification, however carefully it may have been planned and arranged; and it is more than probable that the future will suggest changes in the details of this structure, although its general arrangement has so far proved entirely satisfactory.

An experimental piggery, built of stone, 48 x 24 feet, inside measurement, having ten pens separated longitudinally by a four-foot alley, we hope soon to erect at a point east of the new barn and at right angles to it. The south wall of this piggery is to form the north wall of a shed, 24 x 48 feet, which will be built the coming summer for the further protection of the barnyard. This shed will have a hay loft throughout its entire length, the floor of the loft being continuous with the threshing floor of the barn.

CORN MEAL AND CORN-AND-COB MEAL FOR BEEF-MAKING.

The experiment hereinafter detailed is a repetition of the one with fattening steers made at this College in the winter of 1883-84. As may be inferred from the heading, the question under examination in each instance was the relative values of clear corn meal and meal made by grinding corn with the supporting cob; using both as feed for steers uniform in age, quality and general condition.

The abundant corn crops of the past two or three years in Kansas, and generally throughout the Union, and the steadily-narrowing margin of profits in feeding, due to a variety of causes, have compelled the practice of the most economical methods in feeding; and thus an increasing public interest in the question involved in this experiment is noticeable. No better evidence of this fact is needed than that furnished by the great number and variety of corn crushers and farm mills adapted to reducing ear corn, many of which have attained to a wide and apparently enduring popularity. The principal reason for the very varied opinions current among farmers and stockmen as to the value of ground ear corn, is the difference in the methods of operating these farm mills. Thus, a considerable stock-raiser who complained that he got but little if any gain from grinding, I found, on examination, did not grind in any proper sense: the feed as it escaped from the mill was simply a mass of broken cobs and shelled corn, only an occasional kernel of the corn having been cracked, while the broken peices of cob averaged half an inch on a side. Another feeder, who was pronounced in his views of the great advantages of grinding, reduced the whole

ear to the condition of a coarse but homogeneous powder. These men had a common name for two very different foods, and this difference in the condition of the grain used by them explains the difference in their estimates of its value. In some such way as this, nearly all of the widely-differing interpretations of the same experience had by different farmers is to be explained.

For the purposes of this experiment, ten steers, "two years old past," were selected in October, 1884. They were a well-grown, very smooth, and tolerably uniform lot, showing Shorthorn blood quite unmistakably. Any judge would at a glance credit them with at least one half of improved Shorthorn blood. No difficulty was experienced in separating the ten into two sets of five each, each set having nearly equal proportions of large and small cattle and good and indifferent feeders. The lot was well suited to the object in view, having been raised by the same individual, under precisely the same conditions. The only objection that could reasonably be urged against them was that perhaps they were in rather better condition at the begininng than was desirable where, as in this case, the effect of food during the entire process of fattening was sought.

The steers were tied up about the middle of November; and until November 26th,—when the experiment really began,—they were gradually accustomed to the full feed of grain, which they received during the entire period of the experiment. They were fed in the shed occupied the previous year by the experimental steers referred to in my Report for 1884, each animal occupying a numbered stall 4 feet in width. During this probationary period, the amount of fodder used was as steadily reduced as the grain ration was increased until about the average minimum quantity required by all was reached. The object in this was to cut off any error liable to arise from feeding a variable fodder ration. That this practice did not result in anoth-

er error, growing out of the artificial condition under which the steers were placed, seems to be shown by the quite common understanding among western feeders that the best results in full feeding are obtained with the smallest consumption of fodder.

The steers, numbered from 1 to 5 inclusive, received, besides the small daily fodder ration, (averaging 8 to 12 pounds) of grain, corn-and-cob meal exclusively; while the second set, numbered 6 to 10 inclusive, were fed, besides the fodder ration, corn meal *ad libitum*. All were fed regularly about 8 A. M., and 4 P. M., and all were watered just before the afternoon feeding. Thus, it will be seen, the only variation in the treatment of the two sets was that made in the character of the grain fed, one lot receiving corn ground with its cob, the other shelled corn reduced to the condition of a coarse meal, or "chop." The experiment was carried on during a period of five months, or, to be accurate, exactly 150 days. The steers were weighed just at the expiration of every ten days of the experiment, and every feed of grain was accurately weighed and recorded.

The only break in the history of this experiment was caused by the loss of the records of the third period, and our inability to weigh the animals at the beginning of the fifth period, caused by an accident to the scales. The absence of data for the third period works a serious injury to the experiment, as it introduces one of the "guesses" which it is the prime object of experiment to remove. The failure to weigh the steers at the beginning of the fifth period is a much less serious matter. The reader will understand, from this explanation, that the totals of food consumed are really short of the true amount by one fifteenth, approximately. This hiatus in the records, unfortunate as it is, does not, however, materially affect results where

comparisons of those obtained in the two sets are made, as the loss was nearly equal in the two series.

The following tables give those facts of the experiment which are susceptible of statistical statement. In all cases, the figures standing for weights refer to pounds and decimals thereof. Where the minus sign (–) precedes a number, a loss is indicated. Those who may wish to compare the facts of this feeding experiment with results obtained in the like one made a year before, can find a full statement of the latter beginning on page five of my Report for 1884: —

TABLE No. I.

Weight of each steer each period (10 days) of the experiment, with totals and averages.

	FEED: CORN-AND-COB MEAL.					FEED: CORN MEAL.				
	No. 1	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.
Nov. 26th, Beginning of Experiment.....	1010	1055	1290	1080	1205	980	1300	1105	1070	1295
Dec. 6th, 1st Period.....	1000	1050	1280	1070	1200	1000	1280	1100	1060	1280
*Dec. 16th, 2d "	——	——	——	——	——	——	——	——	——	——
Dec. 26th, 3d "	1050	1050	1395	1080	1250	1060	1320	1140	1110	1340
Jan. 5th, 4th "	1060	1050	1420	1130	1270	1050	1360	1130	1110	1330
†Jan. 15th, 5th "	——	——	——	——	——	——	——	——	——	——
Jan. 25th, 6th "	1100	1060	1470	1140	1290	1130	1410	1210	1160	1400
Feb. 4th, 7th "	1100	1090	1470	1150	1330	1140	1420	1200	1170	1370
Feb. 14th, 8th "	1120	1110	1500	1170	1330	1140	1450	1180	1190	1390
Feb. 24th, 9th "	1120	1125	1530	1180	1350	1160	1450	1205	1200	1425
Mar. 6th, 10th "	1130	1150	1540	1200	1350	1170	1440	1200	1200	1410
Mar. 16th, 11th "	1150	1165	1560	1220	1365	1180	1450	1210	1220	1430
Mar. 26th, 12th "	1165	1175	1570	1210	1345	1175	1470	1225	1235	1420
April 5th, 13th "	1170	1180	1580	1230	1400	1205	1500	1250	1250	1450
April 15th, 14th "	1180	1195	1620	1240	1410	1225	1520	1270	1260	1465
April 25th, 15th "	1200	1210	1625	1230	1400	1240	1530	1315	1270	1480
Gain per cwt	18.8	14.7	26.0	13.9	16.2	26 6	17.6	19.0	18.7	14 3
Average gain per cwt.....			18.2					18.9		

* By an unfortunate accident the paper containing weighings at the end of 2d period and the weights of feed for 3d period were lost.

† An accident to the scales prevented weighing the steers at the end of 5th period.

TABLE No. II.

The amount of feed in pounds consumed by each steer each period (10 days), and the total amount of feed.

	FEED: CORN-AND-COB MEAL.					FEED: CORN MEAL.				
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.
1st Period	119	155	162	151	157	134	119	165	121	124
2d "	192	161	190	175	182	161	177	181	171	188
3d "	—	—	—	—	—	—	—	—	—	—
4th "	145	147	220	150	182	180	199	169	180	206
5th "	180	131	220	168	180	164	200	156	180	158
6th "	188	167	219	173	180	179	198	179	186	151
7th "	173	167	234	182	195	180	215	153	181	137
8th "	200	159	241	191	201	181	221	93	190	203
9th "	186	160	233	183	191	179	207	136	170	198
10th "	179	174	211	185	193	180	209	142	198	211
11th "	180	178	194	180	200	180	220	142	200	174
12th "	180	135	238	180	200	180	220	171	200	199
13th "	178	153	222	171	190	180	229	172	208	196
14th "	200	177	238	182	199	188	240	176	201	191
15th "	200	180	234	199	198	200	240	181	197	159
Feed consumed by each steer	2500	2244	3056	2170	2648	2466	2894	2216	2583	2495
Feed consumed in each series			12918					12654		

TABLE No. III.

The actual and average gain of each steer each period (10 days) of the experiment.

	FEED: CORN-AND-COB MEAL.						FEED: CORN MEAL.					
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	Average gain.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	Average gain.
1st Period	-10	-5	-10	-10	-5	-8	20	-20	-5	-10	-15	-6
2d " } 3d " }	50	00	115	10	50	45	60	40	40	50	60	50
4th "	10	00	25	50	20	21	-10	40	-10	00	-10	2
5th " } 6th " }	40	10	50	10	20	26	80	50	80	50	70	68
7th "	00	30	00	10	40	16	10	10	-10	10	-30	-2
8th "	20	20	30	20	00	18	00	30	-20	20	20	10
9th "	00	15	30	10	20	15	20	00	25	10	35	18
10th "	10	25	10	20	00	13	10	-10	-5	00	-15	-4
11th "	20	15	20	20	15	18	10	10	10	20	20	14
12th "	15	10	10	-10	-20	1	5	20	15	15	-10	7
13th "	5	5	10	20	55	19	30	30	25	15	30	26
14th "	10	15	40	10	10	17	20	20	20	10	15	17
15th "	20	15	5	-10	-10	4	15	10	45	10	15	19
Total gain.....	190	155	335	150	195		260	230	210	200	185	
Average gain.....			205						217			

TABLE No. IV.

A comparison of results in the two series in definite periods of time.

	FEED: CORN-AND-COB MEAL.						FEED: CORN MEAL.					
	Total feed.	Total gain.	Feed for each 1 lb. of increase.	Gain per cwt. steer.	Average daily feed per steer.	Average daily gain per steer.	Total feed.	Total gain.	Feed for each 1 lb. of increase.	Gain per cwt. steer.	Average daily feed per steer.	Average daily gain per steer.
1st Period	744	-40	00	00	14.8	-0.80	663	-30	00	00	13.2	00
2d "	900	225	—	3.90	18.0	2.25	878	250	—	4.30	17.5	2.50
3d "	—		—		—		—		—			
Totals & Averag's	—	*185*	—	*3.20*	—	*1.23*	—	*220*	—	—	—	—
4th Period.....	844	105	8.0	1.80	16.9	2.10	934	10	93.4	0.17	18.7	0.20
5th "	879	130	13.9	2.10	17.6	1.30	858	330	5.3	5.30	17.7	3.30
6th "	927				18.5		893				18.0	
Totals & Averag's	*2650*	*235*	*11.2*	—	*17.6*	*1.62*	*2685*	*340*	*7.90*	—	*17.9*	*2.27*
7th Period.....	951	80	11.9	1.30	19.0	1.60	866	-10	—	—	17.3	-0.20
8th "	992	90	11.0	1.50	19.8	1.80	888	50	17.6	0.80	17.8	1.00
9th "	953	75	12.7	1.20	19 1	1.50	890	90	9.9	1.40	17.8	1.80
Totals & Averag's	*2896*	*245*	*11.8*	*3.90*	*19.4*	*1.60*	*2644*	*130*	*19.7*	*2.00*	*17.6*	*0.87*
10th Period.....	942	65	14.5	1.03	18.8	1.30	940	-20	—	—	18.8	-0.40
11th "	932	90	10.4	1.40	18.6	1.80	916	70	13.1	1.10	18.3	1.40
12th "	933	5	186.6	0.08	18.7	0.10	970	35	27.7	0.54	19.4	0.70
Totals & Averag's	*2807*	*160*	*17.5*	*2.50*	*18.7*	*1.10*	*2826*	*85*	*33.0*	*1.30*	*18.8*	*0.60*
13th Period	914	95	9.6	1.50	18.3	1.90	985	130	7.6	2.00	19.7	2.60
14th "	996	85	11.7	1.30	19.9	1.70	996	85	11.7	1.30	19.9	1.70
15th "	1011	20	50.5	0.30	20.2	0.40	977	95	10.3	1.40	19.5	1 90
Totals & Averag's	*2921*	*200*	*14 1*	*3.00*	*19 5*	*1 30*	*2958*	*310*	*9.5*	*4.60*	*19.7*	*2.10*

The summary given below will be found convenient in making a direct comparison of the results obtained in this feeding experiment. These results are stated in pounds and decimal of pounds in all cases: —

	Total feed.	Total gain.	Meal consumed for each 1 lb. of increase.	Average daily feed.	Average daily gain of each steer.	Gain per cwt. of each steer.	Average gain.
FEED: CORN-AND-COB MEAL. Steers No 1, 2, 3, 4 and 5.	12918	1025	12 60	17.2	1.44	18.2	205
FEED: CORN MEAL. Steers No. 6, 7, 8, 9 and 10.	12654	1085	11.66	16.9	1.36	18.9	217

The most noticeable fact shown by this summary and the tables on which it is based is the near likeness of the two sets of feeding animals in every one of the particulars named. The two sets consumed almost identical amounts, the one of corn-and-cob meal and the other of clear corn meal; the average daily gain per steer, as well as the gain per cwt., were nearly equal amounts in the two series. When we come to the practically interesting question of the cost in feed of making a pound of beef, we find that while the difference in the two series is still not great, it is in favor of the five steers to which the corn meal was fed, the difference amounting to rather more than thirteen per cent. The loss of the figures for the third week detracts somewhat from the accuracy of a part of the results stated in this summary; for, while the total gain is correctly stated, the amount of feed consumed in this time can only be "guessed." That the ground cob was really useful in flesh production may easily be shown. If we subtract the amount of cob (18 per cent) contained in the corn-and-cob

meal fed, we have 10,593 pounds of corn meal as the total feed of the first series; this, divided by the pounds of feed yielding a pound of increase in the second (corn fed) series, gives 908 pounds as the meat product of the corn, and 117 (1025—908) pounds as the yield of the 2325 pounds of ground cob fed.

That the corn-and-cob meal shows to less advantage than in the experiment made the year previous which showed "that a pound of corn cob when ground and fed to steers with the corn on which it grew is worth more than a pound of meal made from corn alone" is true, but it seems to me plain that the of facts this experiment, without much assumption, furnish the reasons for this difference in results obtained. The winter in which this feeding experiment was made was one of unparalleled length and severity, in Kansas, and during such cold weather the oleaginous and starchy corn meal would much more certainly supply the lost animal heat, and leave a larger residuüm of force for flesh development than the corn-and-cob meal. We get a hint of this from the fact that during the severest weather experienced in the course of the experiment,—the 2d, 3d, and 5th and 6th periods,—the gain made by the corn-and-cob fed steers fell short of the gain made by the corn fed steers in the amount of forty-seven pounds.

The difference in the character and condition of the steers used the in two experiments doubtless also had something to do with this discrepancy in the results obtained. The steers of 1883-84 were a thin, half-grown lot of "natives," while those in use in 1884–85 were high-grade Shorthorns, mature and full-fleshed at the start. The "gain" made by the thin lot necessarily consisted, besides beef, largely of growth in bone and the coarser parts, and towards these elements of growth the ground cob would be likely, on general principles, to make large contributions. The well-

grown and well-bred steers in use during our latest trial, on the other hand, made their increase largely in fat and flesh, and all experience shows the superior excellence of corn when used for fattening animals.

A considerable general experience in the use of corn-and-cob meal as feed for a herd of 60-odd head of neat cattle has greatly strengthened, not only the writer, but those having the practical management of the herd, in the conviction of the superior value of corn-and-cob meal. The corn-and-cob meal was, apparently at least, better digested than was clear corn alone when used; it was eaten certainly with as great relish; the cattle were "off their feed" less often; while cases of diarrhœa caused by overfeeding — all too common when corn meal was used — we repractically unknown when the grain fed was the ground ear corn.

PRACTICAL OBJECTIONS.

The objections to the use of the ground ears as feed are, in my experience, wholly connected with the mechanical operation of grinding. Within the past two years we have used five different mills,— three sweep mills having slow motion and operated by horse power, and two mills the grinding surface of which were chilled iron plates, operated by steam power and having a high rate of speed. All came to us recommended especially for their great usefulness in grinding ear corn. I feel amply qualified to speak positively in this matter of grinding ear corn, having investigated the subject persistently and thoroughly, and at a considerable expense, and have no hesitation in saying that all of our attempts in this direction have ended in failure more or less complete. Not one of the five mills that have been in use upon the College Farm has been nearly satisfactory where the attempt was made to reduce the ears to the condition of a "chop" of even moderate fineness. The record of the operation of these mills may be given in a line:

Their performances were quite variable; their ability to grind shelled corn was anywhere from three to six times greater than their capacity for the reduction of corn in the ear. A recent performance of one of these mills illustrates quite well our general experience with these machines. This mill was operated by a line of shafting connected directly with an engine of nominal ten-horse-power. The engine took steam of 65 pounds pressure. The mill on this occasion was fed as nearly as possible its full capacity of ear corn without crowding. At the end of twenty minutes, the product was found to be exactly 77 pounds, or at the rate of 231 pounds per hour. But that this low rate even could not have been long maintained was shown by the fact that the crusher and grinding plates, at the end of the twenty minutes, had become so greatly heated that a stop would have been inevitable before much more work had been done. After the mill had cooled, it was again put in motion, and for twenty minutes the same power shelled the corn, fanned the grain, after separating it from the cobs, elevated the corn to the mill; grinding at this time exactly 200 pounds to the condition of a fine chop, and doing the work with very much less of strain upon the machinery than was involved in the grinding of the 77 pounds of ear corn.

The lesson of all this to us is, that until we can find a machine that will economically reduce ear corn to the condition of a fine meal, we shall certainly use the clear corn meal as stock food; but when the right mill is found, I am equally confident that we shall use corn-and-cob meal.

COOKED AND RAW CORN AS FOOD FOR FATTENING PIGS.

The value of cooked corn as compared with corn in the raw state was the subject of the experiment hereinafter detailed. Ten pigs, with one exception yearlings, were selected for the purposes of this experiment. As a whole, the lot thus employed was very uniform, the only exception being the occupants of pens number 8 and 10. No. 8 was a six-months-old pig which refused to take kindly to the exclusive corn diet, and consequently was early counted out of the trial. No. 10, the other exception to the rule of uniformity, differed from his companions in that he was a purely-bred Poland-China, and one of superior feeding character, the others being purely-bred and closely-related Berkshires. The behavior of the young pig No. 8 was interesting, because it seems to illustrate a truth of quite general application. This pig, almost from the first, showed a quite variable appetite: he was often troubled with constipation, and had the dry coat and unthrifty appearance which careful managers everywhere strive to avoid in their stock. This case is one of many that have come under my observation in the course of twelve years' experience upon the College Farm, all serving to emphasize what I believe to be the fact, namely, that valuable, unexcelled I may say, as corn is, as an easily accessible fattening food for mature animals, it is for young growing pigs literally a starvation diet.

These pigs were fed twice daily with general regularity at 8 A. M. and 4 P. M.; all were weighed at the end of each ten days, and a careful record made of all weighings. The pigs occupying pens 1 to 5 inclusive were fed cooked shelled corn; those in pens 6 to 10 received raw shelled corn,—as much in both series being fed as was consumed without waste. The figures for cooked corn given in the

tables which follow in every case refer to the weight of the corn before cooking. The corn was weighed before cooking and after, and the proportion of water absorbed in the cooking process subtracted in the case of every feed of every pig. The comparisons therefore wherever made are of cooked corn, weighed before it was cooked, with raw corn simply. In cooking, no set rule was followed except that the corn was so thoroughly acted upon by the heat that each grain might easily be crushed between the thumb and finger. The cooking was done in an ordinary barrel, which was connected with a steam boiler by a half-inch steam pipe which supplied the barrel with steam at a boiler pressure varying from 30 to 60 pounds to the square inch. Water directly from the well was given daily to each pig, as was required.

Almost from the first a considerable practical difficulty was experienced in feeding the cooked corn, but one which of course would be felt in feeding any form of soft feed: during very cold weather, of which much was experienced, the soft, mushy, cooked corn, unless consumed as soon as placed in the trough, would freeze solidly, entailing considerable waste at times. This difficulty was aggravated by the well-known fact that full-fed pigs eat slowly in times of severe cold. On this account it was found occasionally necessary to substitute a small feed of raw corn for the regular ration of cooked corn; but it is believed that this was not done often enough to affect the "totals and averages" obtained in this experiment.

In the following tables the principal facts in regard to feed and gain in each pen are given. The blank results given for the 4th period in table No. 2 are explained by the fact that a terrific "blizzard," which made weighing impossible, prevailed when this operation was to have been performed. The minus sign before the numbers in table No. 2 indicates a loss.

TABLE No. I.

Showing amount of feed consumed each period in each pen, and total feed.

	FEED: COOKED SHELLED CORN.					FEED: RAW SHELLED CORN.				
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.		Pen 9.	Pen 10.
1st Period.	69	67	67	64	62	105	104		89	102
2d "	112	113	108	105	105	122	117		116	120
3d "	149	143	148	129	138	137	132		132	126
4th "	105	104	106	97	95	125	124		116	101
5th "	110	104	105	93	101	117	115		104	112
6th "	75	75	75	62	69	107	113		101	104
7th "	66	62	75	64	61	96	95		92	85
8th "	67	63	68	62	62	100	100		89	90
9th "	58	58	67	53	53	88	85		74	76
Total feed consumed in each pen	811	789	819	729	746	997	985		913	916
Average feed consumed in each pen	778.8					952.5				

TABLE No. II.

Showing gain of each pig during each period of experiment.

	FEED: COOKED SHELLED CORN.					FEED: RAW SHELLED CORN.				
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.		Pen 9.	Pen 10.
1st Period	4	23	8	-7	7	8	12		12	6
2d "	31	8	21	49	9	55	22		34	55
3d "	5	11	10	28	36	57	61		7	23
4th "										
5th "	23	15	13	7	00	20	15		15	16
6th "	00	8	14	-5	00	20	-15		7	12
7th "	29	19	26	24	9	16	6		15	12
8th "	-5	22	14	14	21	16	5		17	7
9th "	18	1	3	2	5	18	9		16	16
Total gain in each pen.	105	107	109	112	87	220	115		123	147
Average gain in each pen	104					151				

TABLE No. III.

The results obtained with each pig, in pounds, together with the total and average results.

	No. of pen.	Wt. of each pig at beginning of experim't.	Weight of each pig at end of experiment.	Gain.	Gain per cwt. of pig.	Feed consumed (lb.)		Feed (lb.) consumed for each cwt. of pig.		Feed (lb.) for 1 lb. of increase.	
						Cooked corn.	Raw corn.	Cooked corn.	Raw corn.	Cooked corn.	Raw corn.
FEED: COOKED CORN.	1	260	365	105	40.3	811		259		7.72	
	2	223	330	107	47.9	789		285		7.37	
	3	246	355	109	44.3	819		272		7.51	
	4	178	290	112	63.4	729		309		6.50	
	5	188	275	87	46.2	746		322		8 57	
Totals.....		—	—	520	—	3894	—	—	—	—	
Averages.....		219	323	104	47.4	778.8		289.7		7.48	
FEED: RAW CORN.	6	260	470	210	80.7		997		273		4.75
	7	300	415	115	38.3		985		275		8.57
	9	217	340	123	56.6		913		328		7.42
	10	233	380	147	63 1		916		299		6.23
Totals...		—	—	—	—	—	3811	—	—	—	—
Averages.....		252.5	401.3	148.8	59.7		952.8		296		6.40

TABLE No. IV.

The results obtained by periods in both series, together with the total and average results.

	FEED: COOKED CORN. Pens 1, 2, 3, 4 and 5.					FEED: RAW CORN. Pens 6, 7, 9 and 10.				
	Average weight of pigs.	Feed (lb.)	Gain (lb.)	Gain (lb.) per cwt., of pig.	Feed (lb.) for 1 lb. of increase.	Average weight of pigs.	Feed (lb.)	Gain (lb.)	Gain (lb.) per cwt. of pig.	Feed (lb.) for 1 lb. of increase.
Dec. 18th, end of 1st period	226	329	35	3 19	9.4	262	400	38	3.61	10.5
" 28th, " " 2d "	260	543	118	9.07	4.6	304	475	166	1.36	2.9
Jan. 7th, " " 3d "	278	707	90	6.47	7.8	341	527	148	10.85	4.2
" 17th, " " 4th "	—	507	—	—	—	—	466	—	—	—
" 27th, " " 5th "	289	513	58	4.01	8.8	357	448	66	4.61	6.8
Feb. 6th, " " 6th "	292	356	17	1.16	20.8	363	425	24	1 65	17 5
" 16th, " " 7th "	313	328	107	6.84	3.06	375	368	49	3.26	8.7
" 26th, " " 8th "	326	322	66	4.04	4 9	388	279	45	2.89	6.2
Mar. 8th, " " 9th "	332	289	29	1.75	9.6	403	323	59	3.66	5.5
Totals	—	3894	520	—	—	—	3811	605	—	—
Averages	—	432.6	57.7	47.5	7.5	—	423	67.2	59 8	6.3

For convenience in making a comparison of results, the following summary, giving the principal facts of the foregoing tables with others in concise form, has been arranged :—

	Total Feed.	Total Gain.	Feed consumed for each pound of increase.	Average daily feed of each pig.	Average daily gain of each pig.	Gain per cwt. of each pig.	Average gain per pig.
Feed—cooked corn. Pigs No. 1, 2, 3, 4, and 5.	3894	520	7.5	8 6	1.1	47.5	104
Feed—raw corn. Pigs No. 6, 7, 9, and 10.	3811	605	6.3	8.4	1.68	59.8	151

Some of the difficulties encountered in the prosecution of this experiment have already been referred to. The cold weather which prevailed during the last four weeks of the trial furnished many annoying interruptions. During periods of severe cold near the close of the experiment, the pigs remained in an almost comatose condition, coming to their feed with evident reluctance, consuming but little and making a proportionally light gain. While the cold weather affected all the pigs alike, so far as relates to externals, the character of the cooked feed — its liability to freeze as soon as placed in the trough — made it extremely difficult to keep accurately the record of feed consumed. Nevertheless it is believed that the errors thus originating were not sufficient to affect the results obtained. I expect in the near future to repeat, under more favorable circumstances, the experiment above detailed.

The figures given above need but little comment. They show as conclusive as figures can show anything that the cooked corn was less useful than the raw grain, the difference in favor of the uncooked corn taking the item of pounds of feed required to make one pound of increase, amounting to exactly one fifth. That this result is not an accident seems abundantly proved by the other items of the summary: the daily consumption of each pig using cooked feed was almost exactly the same as the amount of raw corn used in the pens where raw corn was the exclusive food, but the average daily gain — and of course the total gain — and the gain per hundred weight of pig were in the series using the cooked feed, greatly less than with the pigs using the raw corn. Such an entire unanimity of results can only be explained upon the theory that the cooking was an injurious process so far as its use as food for fattening animals is concerned. With younger animals, whose gain would be made chiefly in growth, the cooked feed might give different results from the forego-

ing; but a considerable general experience does not encourage this belief.

Nothing has been said here of the cost of cooking,—always a very considerable item, both in respect to labor and cost of fuel,—as circumstances, such as mechanical conveniences and cost of labor and fuel, vary greatly the cost of the process in different localities.

PORK FROM THE PASTURE FIELD.

In the early spring of 1885 a rich and productive acre and half of the meadow embraced within the limits of field No. 6 was fenced with the object of ascertaining something of the value of orchard-grass particularly, as summer pasturage for hogs. About one fourth of an acre of this piece of ground was very completely occupied by alfalfa, the remainder being orchard-grass with a slight admixture of red clover and alfalfa, all making a very compact thick-set sward.

On May 11th eight vigorous, eight-months-old shoats were given possession of this enclosure. The alfalfa at this time was about one foot tall and the orchard-grass considerably shorter; but every foot of the acre was occupied by a dense growth of succulent vegetation. These pigs had ranged the cattle yards during the winter, and as the result of "following" corn-fed cattle were thick fleshed — almost "fat." The weight of the lot at the beginning of the experiment was 1522 ℔., an average of nearly 190 ℔. per pig.

Until June 6th the pigs depended wholly on the herbage furnished by the acre, they meanwhile giving evidences of discontent by frequent squealings, and showing by the rapid shrinkage of their forms that their grievances were real. On June 6th the scales showed the lot to weigh 1370 ℔., a loss in twenty-five days of 152 ℔. Evidently, grass and alfalfa alone would keep pigs alive, but it would not hold flesh, at least flesh made from corn. It was plainly evident too that the grass diet must be supplemented with grain in some form, to prevent a further and more rapid falling away. From June 6th to the end of the season two pounds of ear corn were fed daily to each pig.

The following figures show in statistical form the progress of the lot during the experiment:—

May 11th (beginning of the experiment), weight of the eight pigs, 1522 lb
June 6th, weight of the eight pigs, 1370 "

Loss in 26 days, 152 "

The pigs were next weighed July 6th, when, singularly enough, neither gain nor loss was discovered.

July 6th, the eight pigs weighed . . . . . 1370 lb
August 6th they weighed . . . . . 1492 "

Gain from July 6th . . . . . 122 "

September 3d the weight of the eight pigs was . . . 1566 "

Gain from August 6th (28 days) . . . . . 74 "

On October 6th the eight pigs weighed . . . . . 1690 "

Gain from September 3d (33 days) . . . . 124 "

The final weighing was made October 31st, when the lot weighed . . . . . 1710 "

Gain from October 6th (25 days) . . . . . 20 "

The following table gives in concise form the results of the experiment:—

	No. of pigs.	Average weight of pigs (lb.).	Gain (lb.)	Total daily gain.
May 11th, beginning of the experiment	8	190	—	—
May 11th to June 6th	8	171	-152	5.85
June 6th to July 6th	8	171	00	.00
July 6th to Aug. 6th	8	186	122	3.94
Aug. 6th to Sept. 3d	8	196	74	2.64
Sept. 3d to Oct. 6th	8	211	124	3.75
Oct. 6th to Oct. 31st	8	213	20	.80
Totals and averages			188	1.08

Not much need be said additional to the facts given above. These show conclusively enough that this acre and a half of pasture ground was not put to profitable use when employed as hog pasture. That this lack of productiveness was due chiefly to the orchard-grass which made up the bulk of the feed, we have abundant reason for believing. The one fourth acre of alfalfa was kept constantly cropped to a level with the ground; the same may be said of the small amount of red clover, but the orchard-grass was always luxuriant and abundant, covering the ground and rotting upon it in dense masses during the entire season. It was quite commonly remarked by visitors that this field would furnish feed for three times the number of pigs that grazed it. The pigs could not be induced to like the orchard-grass, and I am confident that whatever of gain is attributable to the green feed, should be placed to the alfalfa and clover alone. It may be said of the alfalfa of this experimental acre and half, that, like the alfalfa used in a similar manner the year before, it was almost totally destroyed by the close cropping, only occasional plants showing life the spring following. A considerable general experience, however, has shown that alfalfa is not necessarily injured seriously by the grazing of swine. Where the range is ample, no damage to the sward outside of the narrow paths made by the pigs is likely to result during the winter months.

WARM DRINKING WATER FOR MILCH COWS.

An interesting experiment was begun early in February, having for its object to ascertain the influence of warm water as compared with water at the ordinary temperature of wells, when used as drink for milking cows.

Four cows, two Shorthorns and two Jerseys, were employed in this trial. These cows had been milked steadily for upwards of six months, when the experiment was begun, and, of course, were considerably past the period of full milking. The general plan of the experiment was to feed all of the cows food uniform in quantity and quality each day, and from day to day, while giving them warm drinking water upon alternate days, and water freshly pumped from the well at all other times. This "warm" water during the first three days of the trial was ordinary well water raised to the temperature of 80° Fahr., but after the third day water at 90° was used for two days, and from that time to the end, water at 100° was steadily used. The cows were watered at about 10 o'clock in the morning, running in the yard with the general herd during the remainder of the day. This was the general treatment when either warm or cold water was used, although at times modifications of the plan were found necessary. Thus at the first the cows approached the warm, steaming water with great reluctance, their timidity being heightened by the unusual position in the barn, where the water was furnished. On this account it was found necessary at the first to delay watering in order that strong appetites might neutralize this natural timidity. The difficulty however, was not lasting; after two or three trials of the warm water, a liking for it which amounted to greed was rapidly developed. The cows not merely drank the warm water without hesitation, but rushed eagerly to it and drank to repletion as soon as freed from their stalls. It seems reasonable to suppose that the effect of the drink,

warm and cold, would be noticed in the milk yielded at the two successive milkings which followed the use of the particular drink. In the figures given below, therefore, the milk credited to the warm water is, in every case, the total milk yielded at the evening and morning milkings following the use of that particular drink. I have no doubt that the plan fails to show the true value of either the warm or cold drink — that, in short, the influence of the warm water extends, to some extent, beyond these two milkings, and the cold water in like manner tends to neutralize any effect the warm water may have in milk production. Be all this true, it is not clear that any other plan of operations would be open to fewer objections than the one here employed. The table which follows is a statement of results for every day of the trial:—

	Daily milk yield. Pounds.	
	Drink: warm water.	Drink: water directly from well.
Feb. 9th, Beginning of Experiment		74
" 10th	81	
" 11th		75
" 12th	86	
" 13th		78
" 14th	84	
" 15th		80
" 16th	87	
" 17th		81
" 18th	90	
" 19th		82
" 20th	90	
" 21st		85
" 22d	90	
" 23d		92
" 24th	89	
" 25th		75
" 26th	89	
" 27th		81
" 28th	85	
Totals	871	803
Total increase in milk while warm water was used	68 lb	
Total increase per cent in milk while warm water was used	8.47	

While this experiment, from its brevity and the peculiar circumstances surrounding it, is far from conclusive upon the point under examination, it certainly is suggestive of great value. The fact that at every day except one when warm water was the drink of the cows, a marked increase in the flow of milk was recorded — this increase amounting to fourteen and even eighteen per cent — shows conclusively, as it seems to me, that the warm water was always beneficial. I am confident, however, that this beneficial influence is shown here at the minimum for the reason before stated — that the influ-

ence of the warm and of the cold drink extends beyond the two milkings immediately following, and for the reason that the experiment, because of our inability to complete the steaming machinery earlier, was carried on after the winter had spent its force, during a period of warm "open" weather.

That the loss to stock owners from the use of water in a freezing condition in cold weather, is very great, is strongly suggested by the ordinary winter experiences of the barnyard. The picture of the herd of shivering cattle standing over the trough or partly frozen stream by the half hour, dreading the shock that the freezing water gives to the system, and after drinking, shivering and shaking as if in an ague, is a familiar one to every northern stock-raiser. In striking contrast to this was the behavior of our cows after they had learned the taste of warm water: they drank it greedily in full draughts, afterwards "stretching" themselves with evident comfort and satisfaction. Even the young sucking calves, which ordinarily took cold water with great reluctance if at all, rapidly acquired a taste for the warm drink, sipping it slyly at first, but so on taking it in full draughts.

This experiment seems to suggest a practically valuable use for that on every farm abundant product, woody fiber. This substance, which makes the bulk of the overripe and spoiled fodders, straw, corn-stalks and cobs, to say nothing of recognized fuel materials, is for the most part a waste upon every farm. It is doubtless useful to a limited extent in diluting concentrated foods, and in giving them the bulk needed to call into use the full powers of the digestive organs; but as a food, "that which is capable of being assimilated by an organism," woody fiber has no value. The suggestion of this experiment plainly is that this crude and worthless woody fiber, when in a suitable condition to burn, may be made, in a sense, a valu-

able food; supplying, directly to the animal, heat which otherwise must come from the more expensive digestible foods. The heat thus obtained must be conveyed to the animal in the water he drinks, because the large amount of water consumed daily makes it the necessary vehicle for conveying the largest possible amount of heat to the animal organism. That this is a simple and inexpensive process may be shown by a single fact gathered from general experience: a bushel of bituminous coal burned in an economical boiler we have found to be ample fuel for heating the daily drinking water required by twenty-five cows.

I am unable to think of one of the "leaks of the farm" that may be so easily and with such profitable results stopped as this waste of animal heat. The general proposition, that warm, comfortable quarters,—not mere "shelter,"—supplemented with warm food and drink, are advantageous to domesticated animals, is rarely questioned. I go a step further, and assert that the heat and comfort of animals may be conserved, in the way indicated, to the great financial advantage of their owners.

THICK SEEDING, SUBSOILING AND MANURING FOR CORN.

The experiment made in 1883 in the line suggested by the heading of this article was repeated, in a measure, in 1884 and again in 1885.

Thirteen plats were located in Field No. 1 for the purposes of this experiment. Each plat was 10½ feet wide by 207½ feet long (1-20 of an acre, approximately,) and these plats were arranged and treated subsequently on the general plan employed in previous years: each plat was separated from those adjacent by unoccupied two-foot spaces, and each alternate plat throughout the system, for purposes of comparison, received no special treatment. The operations of plowing and harrowing and all subsequent cultivation, together with the various operations of harvesting were performed in all of the different plats at as nearly as possible the same time.

The soil of these plats was a strong, deep and very fertile loam overlying a clay subsoil not naturally well drained. The kind of corn used was a medium yellow dent of great productiveness.

The operation of subsoiling was performed by the ordinary subsoil plow, working at a depth of four inches in the furrow left by the ordinary plow turning a six-and-a-half-inch deep furrow slice. The manured plats received one and a half two-horse loads—equal to thirty loads per acre—of manure, only partially rotted. The thick seeding of this experiment consisted in planting the corn in drills two and one half feet apart (elsewhere the drills were three and a half feet apart) and doubling the ordinary amount of seed used in each drill, so that the corn plants stood five inches apart in the rows. The ordinary cultivation necessary to keep the ground properly porous and free from weeds was given all the plats.

PLAN OF THE EXPERIMENT.

Size of Plats, 1-20 acre.

Plat A — Plowed 6½ in.
Yield of 3 rows..... { Corn, 277½ lb.
Stalks, 239 "

Plat B—Plowed 6½ in.; subsoiled.
Yield of 3 rows..... { Corn, 233½ lb.
Stalks, 195 "

Plat C—Plowed 6½ in.
Yield of 3 rows..... { Corn, 236 lb.
Stalks, 190 "

Plat D—Plowed 6½ in.; subsoiled.
Yield of 3 rows..... { Corn, 235½ lb.
Stalks, 195 "

Plat E—Plowed 6½ in.
Yield of 3 rows..... { Corn, 219½ lb.
Stalks, 188 "

Plat F—Plowed 6½ in.; manured 1½ loads.
Yield of 3 rows..... { Corn, 230½ lb.
Stalks, 210 "

Plat G—Plowed 6½ in.
Yield of 3 rows..... { Corn, 220 lb.
Stalks, 199 "

Plat H—Plowed 6½ in.; manured 1½ loads.
Yield of 3 rows..... { Corn, 225½ lb.
Stalks, 182 "

Plat I—Plowed 6½ in.
Yield of 3 rows..... { Corn, 202½ lb.
Stalks, 148 "

Plat J—Plowed 6½ in.
Yield of 4 rows..... { Corn, 272 lb.
Stalks, 214 "

Plat K—Plowed 6½ in.
Yield of 3 rows..... { Corn, 194 lb.
Stalks, 185 "

Plat L—Plowed 6½ in.
Yield of 4 rows..... { Corn, 242½ lb.
Stalks, 211 "

Plat M—Plowed 6½ in.
Yield of 3 rows..... { Corn, 195½ lb.
Stalks, 147 "

NORTH.

The facts of the experiment in each plat and in the groups of plats receiving specific treatment are given in full detail in the table and summary which follow:—

	Yield of plat, corn, ℔.	Yield of plat, stalks, ℔.	Yield per acre, corn, bu. (72 ℔.)	Yield per acre, stalks, tons.	Quality of corn.
Plat A—Plowed 6½ in. 3 rows	277.5	239	77	2.39	Good.
" B " " " " subsoiled, " "	233.5	195	65	1.95	"
" C " " " " " "	236	190	66	1.90	"
" D " " " " subsoiled, " "	235.5	195	65	1.75	"
" E " " " " " "	219.5	188	61	1.88	"
" F " " " " manured 1½ loads " "	230.5	210	64	2 10	"
" G " " " " " "	220	199	61	1.99	"
" H " " " " manured 1½ loads " "	225.5	182	63	1.82	"
" I " " " " " "	202.5	148	56	1.48	"
" J " " " " 4 "	272	214	75	2.72	Poor.
" K " " " " 3 "	194	185	54	1.85	Good.
" L " " " " 4 "	242.5	211	67	2.11	Poor.
" M " " " " 3 "	195.5	147	54	1 47	Good.

SUMMARY.

	Yield of Plat Corn, ℔.	Yield of Plat Stalks, ℔.	Yield per A. Corn, bu.	Yield per A. Stalks, tons.
Plats B and D—Plowed 6½ in. and subsoiled. 3 rows	234.5	195	65	1.95
Plats A, C and E—Plowed 6½ in. Adjacent B and D. 3 rows	244.3	206	67	2.06
Plats F and H—Plowed 6½ in.; manured 1½ loads each. 3 rows	228	196	63	1.96
Plats E, G and I—Plowed 6½ in. Adjacent F and H. 3 rows	214	178	59	1 78
Plats J and L—Plowed 6¼ in. Thick seeded. 4 rows	257.2	212	71	2.12
Plats I, K and M—Plowed 6½ in. Adjacent J and L. 3 rows	197.3	160	55	1.60

SUBSOILING.

The subsoiling — always costly work — was of no advantage to the growing crop in this trial. The slightly diminished yield of the subsoiled plats as compared with the flanking — adjacent — ones, which were simply plowed, is due to the slight variations in the soil of the plats, or, perhaps, to slight differences in the treatment given them, and not to any unfavorable influence of subsoiling. All this is strictly in line with the results obtained in the course of three years of previous experimental work, and a considerable general experience had at various times upon the College Farm. We have tried subsoiling during these years upon clay lands of almost every degree of fertility; upon lands that had been in cultivation a considerable number of years and with comparatively new lands; but in no case was there any considerable increase in the yield of the subsoiled plats, certainly none at all commensurate with the cost of subsoiling. All this is plainly shown by the subjoined table, which gives in compact form the results of our subsoiling of corn ground during four years: —

Four Years of Subsoiling Corn Ground.		Yield per acre, corn, bus.	Yield per acre, stalks, tons.
1882	Subsoiled Plats	40	—
	Plowed Plats adjacent subsoil Plats	38	—
1883	Subsoiled Plats	51	1.48
	Plowed Plats adjacent subsoil Plats	54	1.66
1884	Subsoil Plats	64	1.77
	Plowed Plats adjacent subsoil Plats	62	1.42
1885	Subsoil Plats	65	1.95
	Plowed Plats adjacent subsoil Plats	67	2.03
Average yield of subsoiled Plats, 4 years		55	1.73
Average yield of Plowed Plats adjacent subsoil Plats, 4 years		55.25	1.71

Whether different results might have been had upon thinner soils than ours, and especially upon those soils beneath which a tenacious "hard pan" has been formed by the long-continued action of the sole of the plow, we can only conjecture. Certainly only upon such soils does the experiment of subsoiling seem worth trying. Of the total inutility of subsoiling upon the College Farm as it now is, I am abundantly satisfied. As our soils do not seem likely soon to reach the "run down" condition which theoretically offers the most promising field for subsoiling, it seems likely that the work of the past year will, for the present, end subsoiling upon the College Farm.

MANURING.

No considerable increase in the yield either of grain or stalks for the application of the barn-yard manure is noted. This result is quite in harmony with previous experiments. In our experience, manure made during the winter months and hauled afield the following spring is rarely of much benefit to crops grown the first year after such application. The second and third years, however, have generally shown very decidedly the beneficial effects of a dressing of barn-yard manure. Manuring, even when the manure costs nothing, is always an expensive operation; the true policy of Kansas farmers, therefore, is to maintain the condition of the farm by judicious cropping, thorough cultivation and pasturing, so that general manuring may be avoided, and the annual yield of manure applied to particular crops and easily-accessible fields.

THICK SEEDING OF CORN.

Our summary shows for the plats J and L, in which four rows of corn were grown to three in other plats, each row also containing twice as many plants as was grown in the drills of all other plats, a yield of 71 bushels of shelled

corn and 2-12 tons of stalks per acre, — a gain, as compared with the adjacent plat, splanted in the ordinary way, of 16 bushels of corn and one half ton of fodder. These figures do not nearly show the whole difference of results obtained in the two methods of planting; for the quality of the fodder was greatly improved by the thick seeding, while the quality of the corn by the same cause was considerably injured. The ears of corn obtained from the thick-seeded plats were generally small, though sound, and the proportion of "nubbins" to sound ears was great. Nevertheless, this plan of thick seeding is well worth the attention of that large number of Kansas farmers who find themselves each year obliged to look to unusual sources to supplement their ordinary fodder supply. If, as has been repeatedly shown upon the College Farm, we can grow per acre at the slight cost involved in raising and harvesting this fodder crop a mass of stock food such as 65 bushels of corn and 2 tons of fodder is, then we have in the corn-plant resources of stock feed that, so far in this State, have scarcely been touched.

The necessity for greater economy and care in the harvesting and management of the fodder of corn as ordinarily grown is now strongly urged by many agricultural writers. Without doubt this is a field in which practical reform is demanded by every interest of economy. Nevertheless, it must be admitted that the fodder obtained by the ordinary methods of field culture is a coarse and not very valuable feed. The large proportion of coarse stems from which the foliaceous growth has been largely removed by the prevailing winds, the great difficulty experienced in handling and storing this bulky stover, and the great waste that always attends feeding it, are certain always to detract from the value of ordinary corn fodder. But corn thickly planted, as in our experimental plats, of necessity grows fine: the proportion of stems to leaves and

foliage is greatly reduced; on this account it may be easily harvested and stored, while the waste in feeding, from its superior quality, is very light. Such fodder, when freed from the corn, is excellent for nearly all purposes for which ordinary hay is used, but when fed unhusked directly from the feed-cutter, it is an unsurpassed feed for cattle in course of preparation for the shambles.

OUR TAME GRASSES: FACTS AND OPINIONS.

It is not surprising that the early settlers of Kansas were quite indifferent to the advantages derivable from the growth of the cultivated species of grasses and clovers. Farmers rarely look beyond the immediate necessities of their situation, and the pioneers of Kansas were no exception to the general rule. They had at their doors the largest and probably the most productive natural meadows to be found on the North American continent. While sister States had been blessed with the coarser growth of trees and shrubs, Nature had made of Kansas one great hay and pasture field. Everywhere grass was abundant, so abundant as to be a constant obstacle to the farmer, and a threat to buildings and fences during all the long season when the prairie fires pretty constantly lit up the western skies. The conservation of the native grasses and the introduction of new have never until quite recently been the purpose of Kansas farmers.

Nor is much good likely to come of any efforts that may be put forth with the object of saving the remnant of our native grasses. The grasses which compose these are, beyond a question, among the most vigorous and nutritive known; no grasses among cultivated sorts can surpass, if any can equal, them in ability to withstand insect ravages and all the peculiar exigencies of the western climate: but in saying this, we have exhausted the list of their good qualities. On the other hand, these wild species make no growth, and consequently give no feed worth speaking of, except during the summer heats, and all with exception of the "buffalo grass," so called, are worthless, usually, long before the first frosts of fall are felt. Moreover, these wild grasses will not endure close grazing or the constant

tramping necessary where pasturing herds are kept within the limits of fields. For these reasons and others that might be given, our native grasses are rapidly passing away, and no hand is lifted to arrest their downfall.

THE GROWTH OF THE IDEA.

Perhaps the most encouraging fact in connection with the recent great agricultural development of the State is the gradual and successful substitution of the cultivated grasses and clovers for the failing wild grasses. For a distance of fully one hundred and fifty miles west of the Missouri river fields of grass and clover are common, and every year adds enormously to the area thus employed. The "tame grass question," which ten years ago was regarded by most Kansas farmers as a "question" and a "problem" of doubtful issue, is now as generally considered settled in favor of the great usefulness and entire practicability of a considerable and increasing list of grasses and clovers. That this tame-grass idea will, with the practices underlying it, get a steady expansion in the agriculture of the State, thus ridding our farms of their foulness, increasing their fertility and productiveness, and adding to their beauty, no one at all familiar with the facts can doubt.

KINDS SUITABLE AND UNSUITABLE.

The kinds of grasses and clovers grown in the latitude of Kansas east of the Missouri river may generally, but not always profitably, be grown in the same latitude west of the river. As we pass westward from the eastern boundary of the State, the rapidly increasing altitude and variableness of the climate are obstacles in the way of the successful cultivation of many familiar Eastern sorts: so that the facts of experience obtained along our eastern border cannot be successfully applied in the central and

western portions of the State. In general, it may be said that no grass or clover can be permanently successful in Kansas that has not the ability to withstand high temperatures and drouths as well as severe freezing. Such peculiarly Southern sorts as Johnson grass and Bermuda grass are totally worthless in Kansas, because, if not wholly destroyed by the severity of our winters, they are so completely crippled as to be of no practical value. In the course of a long experience with tame grasses in Kansas, the idea has steadily grown with me that orchard-grass is generally our best and most useful grass, and that for mixed pastures and mowing ground, orchard-grass and red clover have a position in Kansas as permanent as that held by Timothy and clover further east. Alfalfa is also sure to be a favorite with Kansas cultivators, although a wider experience is needed to determine accurately its place. Of the many other sorts favorably known in different localities, and which have been the subjects of persistent trial upon the College Farm, not much needs to be said here. Timothy, though uncertain, frequently gives a large yield of valuable hay, but it suffers from dry weather and insects (particularly chinch-bugs), and it gives no pasturage worth mentioning. Kentucky blue-grass is a persistent grower in Kansas under almost every circumstance of climate and soil. It will in time drive almost every other sort from the soil in which it gets foothold. Despite these good qualities, it is, except for lawns, of little use to Kansas farmers. It yields no hay, of course, and the amount of pasturage yielded by it is inconsiderable. Perennial rye-grass (*Lolium perenne*), although repeatedly tried, often with good prospects of success, has, I believe, never survived the second winter. Tall meadow oat-grass (*Avena elatior*) is, on many accounts, a useful grass. It gives very early and excellent pasturage, and a stand with it is easily obtained, but the yield of hay is

light and apparently not very palatable, and it suffers greatly from "dry spells." Common white clover starts early in the spring, and for a time makes abundant pasturage; but as the summer advances, it fails rapidly, frequently perishing, but re-seeding and almost certainly reäppearing the following spring. A stand of red-top has proved quite difficult to secure with us, doubtless on account of the smallness of its seeds. Except in swales, or other like moist situations, this is not a promising sort. Many other sorts might be referred to here, but the list given embraces nearly every kind that is likely to be the subject of trial in Kansas.

GRASS LAND — HOW PREPARED.

In our experience, the best results have been obtained with most sorts of artificial grasses upon a fertile clay loam, resting on a permeable clay subsoil. But, let it be remembered, land can hardly be too rich or too highly manured for grasses. Indeed, we have found that not only are the largest yields obtained upon such fertile lands, but the effect of insect depredations is greatly lessened. Of course, comparatively poor lands, in Kansas as elsewhere, will grow grass; but poor lands produce poor crops everywhere. Better far, commence the growth of the tame species of grass before the land has become impoverished by injudicious cropping.

But, whatever may be the character of the soil, prepare it as well and thoroughly, by plowing and harrowing, as for any grain crop. This is a rule with scarcely any exception; and its violation in many ways explains a large proportion of the failures that have attended the attempted cultivation of tame grasses in Kansas.

FAILURES—CAUSES AND REMEDIES.

Still, failures are made in the cultivation of grasses, and often when it is not easy to name the causes. For exam-

ple, a farmer writes me from a very rich agricultural section, that, upon his farm, orchard-grass starts readily, and no difficulty is experienced in getting a stand, but it fails to get the growth of stalk and seed which makes the bulk of hay, growing fairly thick, but never getting far from the ground. This is a very unusual complaint, and, indeed, complaints of any kind about orchard-grass are unusual; but with alfalfa failure to make a vigorous growth is much oftener reported. These failures are, without doubt, generally due to causes peculiar to the locality, and, without a knowledge of these, it is impossible to name their remedy, except in a general way. I am confident, however, that deeper plowing, with liberal application of farmyard manure, are the sure remedies for nine tenths of the failures made with grasses and clovers in the agricultural portions of the State. In portions of England and Scotland, now famous for turnip culture, the complaint of failure with roots was nearly universal until, by the use of superphosphates and thorough draining and liberal culture, the land was brought into a condition which enabled it to support the turnip crop. In like manner, many of our Kansas soils demand more liberal treatment from the husbandman before they can be brought up to their full capacity for usefulness.

WHEN TO SOW.

I am unable to add much to the recommendations under this head contained in my report for 1883: —

"The time to sow grass seed is, without exception, in the spring; and recent experience shows that this work should not be undertaken too early in the season. Seed sowed after the spring rains have fairly set in has never failed since 1874 to give a good stand of grass. In a few instances, and where the winter following has been warm and open, we have had good success with Timothy and

clover sown in fall; but the result of sowing orchard grass, alfalfa and blue-grass in the fall has been almost certainly disastrous. My experience with grass seeds sown in the fall has been this: they germinate readily, even more quickly than in spring, but, as the native vegetation fails from the action of the frosts, the young grasshoppers collect upon the young grass, doing it serious damage; what remains suffers seriously, and is often quite destroyed by the action of the frosts and violent winds of early spring. On the other hand, when the seeding is done too late in the spring, the young and tender plants are consumed by the sun as fast as they appear above the ground. Seed sown any time during the month of April will rarely fail to germinate and make a vigorous growth. However, I cannot advise seeding, as before said, until the warm spring rains set in. I have sown both alfalfa and orchard-grass during the early part of May with excellent results."

I am aware that by many the view is held that, inasmuch as the plant casts its seed in the fall season, this is Nature's own time for the sowing of seeds, and that, in this respect as in so many others, art can do no better than to copy nature. To this, answer may be made, that nature in her seeding operations is wasteful in the extreme, sowing a thousand seeds that come to nothing for every one that develops a plant. Moreover, this argument for fall-seeding applies equally in the case of corn, oats and similar "spring" grains, which, in a state of nature, are equally with grass seeds sown in the fall. Fall-seeding may be said to be better than seeding in the spring in the case of all plants which make a growth in the fall sufficiently strong to withstand the rigors of winter. This, corn and oats and most of our grasses will not do.

DO NOT SEED WITH OTHER CROPS.

In growing corn or wheat, the presence of any other plant, as rye or blue-grass, though intrinsically valuable, is accounted a detriment to the growing crop. The plant is "out of place," and, in the estimation of the farmer, a weed. So oats or wheat or rye, among which grass seed has been sown, is a serious detriment to the growing grass, and the grass plants, without doubt, are injurious to the grain. It is often argued that the tall grain will shade and protect the young grass. But grass does not need shade when sown in proper season: it needs the sun; and, especially, it needs moisture, and this the vigorous grain is continually taking from the soil, thus robbing the young grass from the start. Every farmer knows how spindling, sickly, and lacking in strength of root and stem, is a grass or clover plant growing in a dense mass of grain. When this grain is harvested in June or July, just when the summer heats are greatest, the delicate, starved grass plants are certain to perish, unless long-continued cool and cloudy weather prevents.

We are aware that, on favorable seasons, considerable success is obtained by seeding the grass with another crop. But, even during these favorable seasons, a better and more vigorous stand may be obtained without the rivalry of vigorous grains; and, upon dry seasons, a failure of the grass is almost certain, when seeded with a grain crop.

Alfalfa, or Lucern (*Medicago sativa*).—For this crop the ground should receive thorough preparation by plowing and harrowing. Sow not less than twenty pounds of of seed per acre, and sow this about the middle of April; harrow in lightly, following with a roller if possible. Do not be discouraged if the plants make a feeble growth during the first season, as they usually do. Alfalfa should not be pastured or mowed during this first and critical season. The mower should occasionally be run over the

ground high enough to miss the alfalfa and cut off the tops of the weeds. After this season the alfalfa will take care of itself and all the weeds within its reach. Alfalfa is, without doubt, one of the most valuable of the forage plants of Kansas. Wherever irrigation is possible, alfalfa is simply invaluable; but even in the central and eastern portions of the State, it is a profitable and eminently satisfactory forage crop. Very close pasturing late in the season, and very severe freezing when the ground is not well protected with snow, have proved almost certainly fatal to alfalfa; and the stand, after the third or fourth year, usually becomes so thin as to make it no longer a profitable crop. Like orchard-grass, alfalfa never self-seeds or thickens or spreads in the least beyond the ground originally seeded. Alfalfa makes good pasture for stock of all kinds, and is quite unequaled among forage crops for "hog pastures." It yields enormously of hay, of an inferior quality, I am bound to add. We have cut four crops of a ton and a half of hay per acre from the same ground the past year. Nevertheless, in a country which gets its moisture directly from the clouds, it will not pay to raise alfalfa for its hay. Alfalfa should have much field room after cutting. If dried hastily, the valuable portions of the plant — the leaves — will break off in handling and be lost, and only woody, inedible stalks remain. It should be cured slowly in the windrow and "cock" — at best a slow operation; and if, meanwhile, a considerable shower falls, the hay is almost certainly ruined beyond recovery.

Orchard-grass (*Dactylis glomerata*).—Every year's experience adds to my good opinions of orchard-grass. For every section of the State, I say, without any kind of reservation, it is the first kind to try, as the one of all others most likely to succeed. In the eastern section of the State it competes successfully with blue-grass in the amount and excellence of the pasturage it furnishes, and with

Timothy in the production of hay; while in the central and western portions, it has been grown with excellent success after all others have failed. Orchard-grass is one of the earliest grasses to start in the spring, and the last to succumb to frost in the fall. By giving it a good start in the fall, it will furnish good pasture far into the winter. It is consumed with great relish by stock of all kinds, especially if the grass is cropped short. It seems to do equally well upon heavy clay and sandy soils; and any rich and well-drained soil seems suited to it.

It should be remembered that orchard-grass will not make a sod as blue-grass does. It always grows in tussocks, and thick-seeding is generally recommended to counteract this tendency to growth in bunches. I am strongly of the opinion, that this is mistaken advice, and that much larger yields of pasturage and hay will be furnished by a given area of ground when the orchard-grass is allowed to have its own way, unchecked by crowding. About 1½ bushels of seed should be sown per acre; and not much more will, under any circumstance, be required. I have obtained excellent results by adding to the above three quarts of red clover seed. The clover has always thrived with the orchard-grass, besides furnishing to animals that variety of food so agreeable to the taste. In my experience, no amount of tramping or close grazing at any season has been able to injure a well-rooted orchard-grass sod. It will endure late seeding better perhaps than any other sort; but this operation ought not to be delayed much beyond the middle of April.

Orchard-grass upon the College Farm, and quite generally in the neighborhood, was almost totally destroyed last winter, presumably by surface ice, *except in case of that seeded the spring before*, which, in the most exposed situations, was uninjured. This is the first accident of the

kind that we have had to record in the course of eleven years of experience with orchard-grass.

Red Clover (*Trifolium pratense*) is probably, in the eastern and central counties of the State, as reliable and as useful a crop as in New York or Ohio. Indeed, here in Kansas this useful plant adds another to the long list of its valuable qualities, in that it never "runs out" as in the East, but constantly thickens and sustains itself by self-seeding. In very dry seasons, however, clover lacks the "staying" qualities so remarkable in alfalfa. But while drouth generally reduces the yield,—as of all other crops,—it will rarely, upon a clay soil, permanently injure the plants. Regarding the relative merits of clover and alfalfa,—a question often raised,—I have to say that, while clover yields scarcely more than half the hay or pasturage given by alfalfa, in point of quality, alfalfa is greatly inferior. The stalks of alfalfa are nearly solid and woody, and the waste in feeding is great as compared with clover.

English Blue-grass (*Festuca elatior*).—As far west as Manhattan, this fescue has shown permanent value. While it suffers from dry weather,—as what grass does not?—it retains its hold upon the soil, furnishing in favorable seasons excellent hay and pasturage. It must hold a position in Kansas agriculture greatly below orchard-grass; but that increased experience will discover for it a permanent position, I have no doubt.

Texas Blue-grass (*Poa arachnifera*).—Of this new sort, I said in my report for 1884, that it seemed "to promise much for the winter grazier being apparently greatly superior for use in this section to its near relative, Kentucky blue-grass." Texas blue-grass makes a very early and vigorous growth, and even during periods of drouth and severe freezing, the peculiar bright purple-green of its foliage is scarcely diminished. This grass is of a much coarser habit than the common blue-grass; it will cut a

good swath of hay ; and while it does not apparently make as firm and compact a sod as Kentucky blue-grass does. it yet occupies the ground very completely. I have seen enough of this new favorite to warrant me in the statement that it will, without injury, withstand every exigency of our climate, and furnish treble the feed or hay that ordinary blue-grass will furnish. Of the amount of seed required, or indeed whether it may be propagated from seed at all, I am unable to speak without further experience.

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